W. B. No. 872

U. S. DEPARTMENT OF AGRICULTURE
WEATHER BUREAU

MONTHLY WEATHER REVIEW

VOLUME 53, No. 6

JUNE, 1925

WASHINGTON
GOVERNMENT PRINTING OFFICE
1925

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MONTHLY WEATHER REVIEW

Editor, ALFRED J. HENRY — Assistant Editor, BURTON M. VARNEY

Vol. 53, No. 6
W. B. No. 872

JUNE, 1925

CLOSED AUGUST 3, 1925
ISSUED AUGUST 29, 1925

INVESTIGATION OF THE DUST CONTENT OF THE ATMOSPHERE

By HERBERT H. KIMBALL and IRVING F. HAND

SYNOPSIS

This paper summarizes determinations of the dust content of the atmosphere made at the American University, D. C., with an Owens dust counter. Variations with the seasons and with the direction and velocity of the wind are shown, and are attributed principally to smoke from the near-by city of Washington. A close relation is shown between the limit of horizontal visibility and the dustiness of the atmosphere.

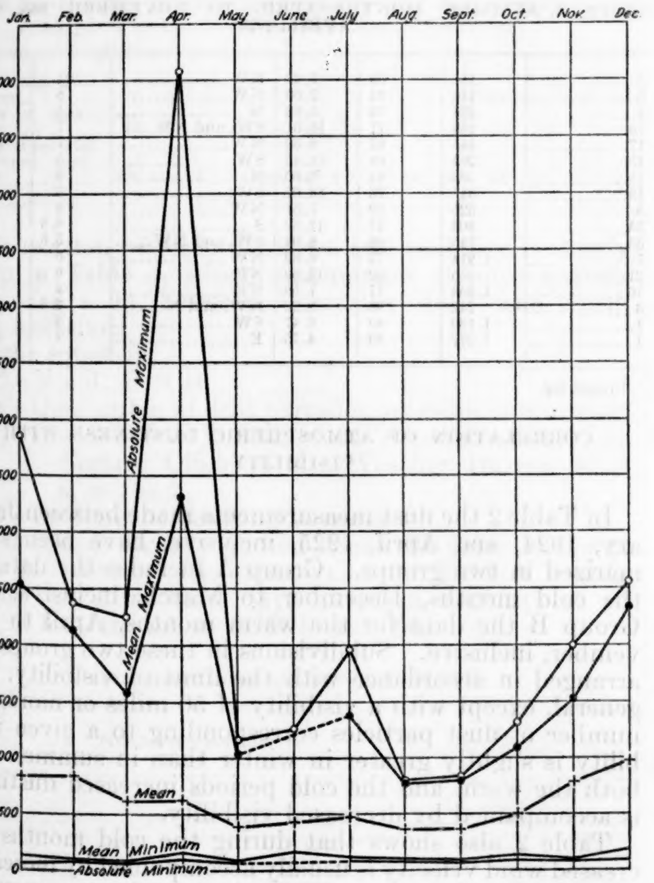


FIG. 1.—Monthly means and extremes of the dust content of the atmosphere at the American University, D. C.

Determinations made during free-balloon flights show considerably less dust than was found during previous airplane flights.

Spores were observed at intervals in 1924 between July 12 and November 21. They were first observed in 1925 on June 8.

INTRODUCTION

The results here summarized are in continuation of those published in the MONTHLY WEATHER REVIEW for March, 1924, 52:133–141. The Owens dust counter, shown in Figure 1 of that paper, has been used to deposit the dust from a known volume of air on a microscope cover glass. The dust thus deposited has been examined and counted by means of a high-power miscroscope in the manner described in the same paper.

Unless otherwise stated, all dust determinations have been made at the American University, which is northwest of the city of Washington at a distance of about 2 miles from the section known as Georgetown, 4 miles from the White House, 5½ miles from the Capitol, and 5 miles or more from all important railroads. The tabulated summaries that follow include observations made at 8 a.m. only.

Seasonal variations.—In Table 1 are given the monthly means, the monthly maxima, and the monthly minima of dust determinations from the beginning of observations in December, 1922, to April, 1925, inclusive. The monthly averages and extremes are also shown graphically in Figure 1. Aside from the marked increase in dustiness during the winter season, there are considerable variations in monthly values from year to year, and especially in the maxima. These variations are undoubtedly due principally to local smoke from the city, and they will probably increase in magnitude, as building operations are rapidly extending the residence section to the north and south of the university.

TABLE 1.—*Dust content of the atmosphere at the American University, D. C., at 8 a. m. (dust particles per cubic centimeter)*

Year	January	February	March	April	May	June	July	August	September	October	November	December
MONTHLY MEANS												
1922												1,208
1923	1,061	905	540	476	393		397	388	386	395	451	557
1924	719	533	409	645	376	420	539	326	335	598	1,110	1,159
1925	723	1,092	909	753								
Means	834	843	619	625	384	420	468	357	360	496	780	975
MAXIMUM												
1922												2,088
1923	3,860	2,050	1,155	1,182	905		793	794	812	853	1,023	2,340
1924	2,403	1,964	1,280	1,661	1,154	1,250	1,953	796	823	1,306	1,987	2,551
1925	1,352	2,370	2,247	7,077								
Means	2,538	2,128	1,561	3,304	1,030	1,250	1,373	795	818	1,080	1,505	2,326
Extremes	3,860	2,370	2,247	7,077	1,154		1,953	796	823	1,306	1,987	2,551
MINIMUM												
1922												298
1923	214	105	113	113	65		90	110	59	96	71	90
1924	124	97	76	151	124	155	124	87	97	155	113	124
1925	57	77	87	202								
Means	132	93	92	155	94	155	107	98	78	126	92	171
Extremes	57	77	76	113	65		90	87	59	96	71	90

56302—25†——1

The remarkably high maximum of 7,077 in April was obtained at 8 a. m. on April 7, 1925. A smoke cloud that in the absence of wind had collected over the city in the early morning was lifted by convection and carried by a light easterly wind over the university. By noon the sky had cleared, and the dust content was only 166 parti-

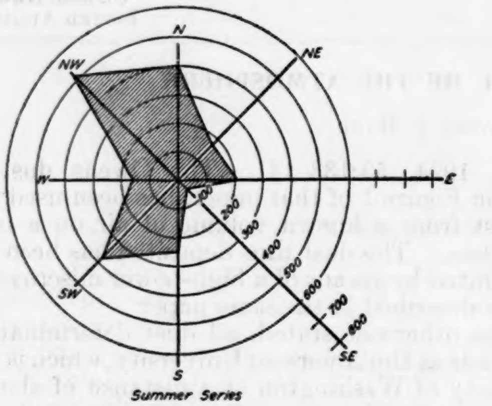


FIG. 2.—Variation in the dust content of the atmosphere with wind direction during the warm months (April to November). Note: The average dust content (particles per c. c.) with each wind direction is indicated by the length of the straight line drawn for that direction. The shaded area at the center of the figure indicates the relative frequency of winds from the different directions

cles per cubic centimeter, or less than the minimum for the month at 8 a. m., and the visibility had increased from three-fourths to 30 miles.[1] The July maximum of 1,953 was obtained on July 21, 1924, a day with dense haze.

Variation with wind direction.—Figures 2 and 3 show the variations in the dust content of the atmosphere with wind direction in the warm (April–November) and the cold (December–March) months, respectively. The

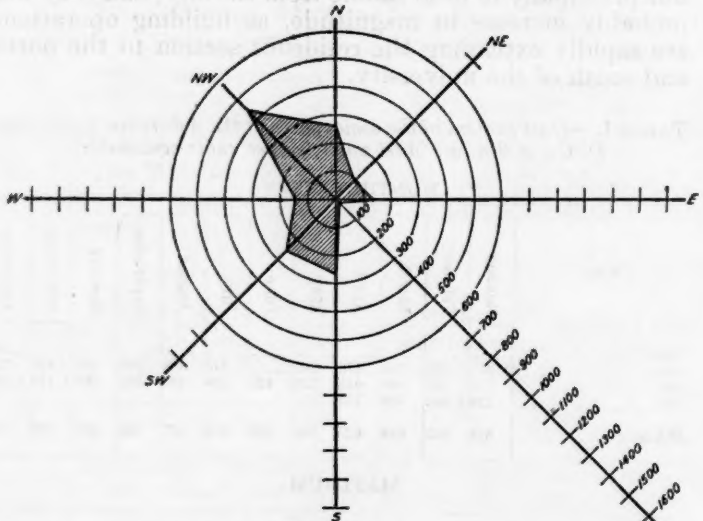


FIG. 3.—Variation in the dust content of the atmosphere with wind direction during the cold months (December–March). Note: The average dust content (particles per c. c.) with each wind direction is indicated by the length of the straight line drawn for that direction. The shaded area at the center of the figure indicates the relative frequency of winds from the different directions

preponderance of dust when the wind is from an easterly direction undoubtedly is due to city influence. The secondary winter maximum with west winds may be due to smoke from the heating plant of the nitrate fixation laboratory, which is about 600 feet west of the college of history building where the dust records are obtained. In winter the minimum dust content is found with northwest winds; in summer, with west to north winds.

[1] See Hand, Irving F. Effect of local smoke on visibility and solar radiation intensities. This REVIEW, April, 1925, **53**: 147–148.

TABLE 2.—*Summary of atmospheric dust counts, American Unisity, 8 a. m.*

GROUP A. WINTER MONTHS—JANUARY TO MARCH, 1924; DECEMBER, 1924, TO MARCH, 1925

Number of observations	N per c. c.	Humidity		Wind		Visibility
		R. H.	e	Dir.	Vel.	
		Per cent	*Mm.*		*M. p. h.*	*Miles*
2	68	58	2.36	NW	14	68
7	110	59	3.53	NW	14	50
13	221	63	3.62	NW	9	30
10	428	60	2.81	NW	8	30
18	317	61	1.96	NW. and N	9	20
5	498	66	2.33	NW	6	20
5	705	64	2.36	N	8	12
3	600	60	2.46	N	4	10
15	381	70	3.37	N	7	5
26	748	68	3.45	NW	5.2	5
20	1,495	75	3.80	NW	5	5
10	641	83	3.60	NE	7	3
16	1,744	77	4.78	S	4	3
1	865	68	2.62	E	8	2
9	1,640	83	4.43		4	1

GROUP B. SUMMER MONTHS—APRIL TO NOVEMBER, 1924, AND APRIL, 1925

Number of observations	N per c. c.	R. H.	e	Dir.	Vel.	Visibility
3	114	59	7.47	NW	11	68
6	146	63	7.09	NW	8	50
4	224	73	5.88	W	4	50
16	169	71	11.01	SW. and NW	7	30
17	345	63	8.50	NW	7	30
15	263	68	11.45	SW	5	20
11	592	64	6.60	N	8	20
13	347	73	14.07	SW	3	12
8	625	69	7.31	NW	4	10
34	403	77	11.52	S	4.5	5
33	745	66	8.94	SW. and NW	5.5	5
7	1,214	73	6.82	NW	6	5
21	535	82	12.52	NE	6	3
16	1,453	77	7.58	NE	4	3
3	742	96	9.20	NW. and N	2.5	[1] 1
1	1,180	83	9.47	SW	2	1
1	7,077	83	4.75	E	1	¾

[1] Light fog.

CORRELATION OF ATMOSPHERIC DUSTINESS WITH VISIBILITY

In Table 2 the dust measurements made between January, 1924, and April, 1925, inclusive, have been summarized in two groups. Group A includes the data for the cold months, December to March, inclusive, and Group B the data for the warm months, April to November, inclusive. Subdivisions in these two groups are arranged in accordance with the limit of visibility. In general, except with a visibility of 50 miles or more, the number of dust particles corresponding to a given visibility is slightly greater in winter than in summer. In both the warm and the cold periods increased dustiness is accompanied by decreased visibility.

Table 2 also shows that during the cold months decreased wind velocity is usually accompanied by increased atmospheric dustiness. While there is the same general tendency in the warm months, Table 3 and Figure 4 show a rather marked departure from the rule with winds of 8 to 9 miles per hour. Only 10 observations are available with winds of 9 miles. One of these was with a northeast wind and a dust content of 553 particles per cubic centimeter; four with an east wind and an average dust content of 482; the other five with northwest wind and an average dust content of 892. On one of these latter "Dense haze and smoke" was recorded and on another "haze on the horizon." It may be that winds of this velocity at 8 a. m. in summer are indicative of sufficient wind movement during the day to introduce

considerable surface dust into the atmosphere, while at Washington winds of higher velocity usually follow rainstorms that have washed out the dust from the atmosphere and left the ground surface moist.

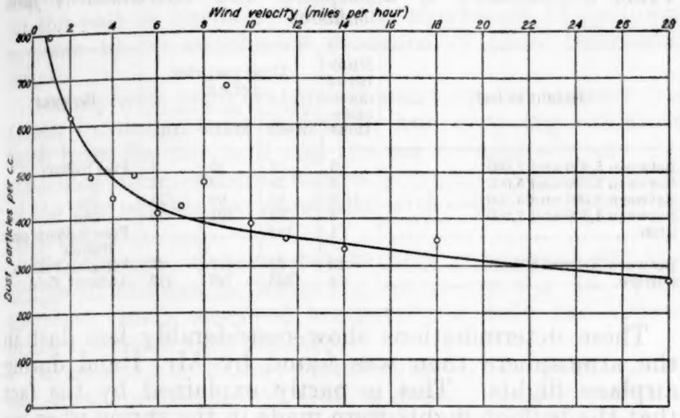


FIG. 4.—The relation between wind velocity and the dust content of the atmosphere during the warm months (April to November)

TABLE 3.—*Relation between wind velocity and dust content of the atmosphere in the warm months (April–November)*

Wind velocity, miles per hour	1	2	3	4	5	6	7	8	9	10	11–12	13–15	16–20	28
Number of occurrences	39	53	44	50	25	49	10	31	10	22	31	11	5	1
Number of particles per cubic centimeter	796	619	481	444	496	412	427	476	684	390	358	335	353	269

The relation between dustiness and visibility is clearly shown in Table 4, which summarizes all observations made at 8 a. m. between December, 1922, and April, 1925, inclusive.

In the equation,

$C = N \times R.\ H. \times D$,

N = the number of dust particles per cubic centimeter.

R. H. = the relative humidity as determined at the Central Office of the Weather Bureau at 8 a. m., and

D = the limit of visibility in miles.

In the paper already quoted above the value of C was given as 480,000. The mean value for Table 4 is only 390,000; or, if we omit days having a visibility of 10 miles or less, the mean value is 435,000.

TABLE 4.—*Values of $C = N \times R.\ H. \times D$*

Number of observations	D, visibility	C
	Miles	
5	68	362,800
33	50	408,200
78	30	528,150
44	20	484,600
17	16	415,700
18	12	407,700
53	10	338,700
212	5	263,900
90	3	246,300
1	¾	440,500
Mean		390,000
Mean, excluding values for D = 10 or less		435,000

The maximum value of C is for a distance of 30 miles. This is probably due to the fact that Sugar Loaf Mountain, an isolated peak, is at that distance from the university in a northwesterly direction. It is therefore not only a conspicuous object, but it is in a favorable direction for observing during the morning. The peaks in the Blue Ridge Mountains 68 miles west of the university are so little higher than other mountain ranges in the same direction that they can be identified only when the background as well as the intervening atmosphere is favorable. Objects visible at 10 to 20 miles are ranges of hills without marked characteristics. The towers of the Arlington Radio Station, at a distance of 5 miles, are conspicuous, but the intervening valley of the Potomac is apt to be smoky in the early morning.

On April 7, 1925, the visibility was carefully determined as three-fourths mile. This value, with the dust content, N, of 7,077, and a relative humidity of 83, gives for C the value of 440,500. On this date the dust was due principally to smoke, and the particles were larger than the average. Undoubtedly this is generally true when the visibility is less than 20 miles, as in such cases local smoke often plays an important part.

No doubt the size of the dust particles is generally a factor in determining the limits of visibility. For example, in October, 1924, the Blue Ridge Mountains at a distance of 50 miles were seen four times, with an average atmospheric dust content of 224 and an average relative humidity of 73, giving a mean value for C of 817,600. This was one of the driest months Washington has ever experienced, and the haziness of the atmosphere was pronounced. The dust particles were below the average in size. On the remaining six days during the warm months of 1924–25 on which a visibility of 50 miles was recorded, a mean dust content of 146 and an average relative humidity of 63 give for the value of C 459,900. On July 21, 1924 a day with dense haze, a dust content of 1,953, a relative humidity of 82, and a visibility of 3 miles give for the value of C 470,400. On July 12, 1924, at 8 a. m., the time of observation, a fire was in progress at the Benning stockyards, about 8 miles southeast of the university. The wind was 6 miles per hour from the south. A dust content of 1,659, a relative humidity of 93, and a visibility of 3 miles, give for the value of C, 465,000.

Diurnal variation in atmospheric dustiness.—On international days, as designated by the International Committee for the Exploration of the High Atmosphere, dust determinations are made at noon as well as at 8 a. m.

Between February, 1923, and April, 1925, observations on 16 days during the cold months, December to March, inclusive, give for the 8 a. m. mean 819 dust particles per cubic centimeter and for the corresponding noon mean, 627. During the same period observations on 40 days during the warm months, April to November, inclusive, give for the 8 a. m. mean 641, and for the corresponding noon mean, 414. For the entire period the 56 noon determinations show only 69 per cent as many dust particles per cubic centimeter as the 8 a. m. determinations. This is probably the result of the clearing of the atmosphere of local dust and smoke by the increase of wind velocity during the forenoon.

OBSERVATIONS FROM BALLOONS

During April and May, 1924, determinations of the dust content of the atmosphere were made by Dr. C. LeRoy Meisinger in connection with balloon flights from Scott Field, Ill. On account of the regrettable accident that led to the death of Doctor Meisinger on his last flight we have not been able to interpret his brief notes as fully as would have been the case had it been possible to consult with him in regard to them. The dust counter used by Mr. Hand during airplane flights in 1923 was employed, and the cover glasses were examined and the dust counts made by Mr. Hand after their receipt in Washington.

TABLE 5.—*Determinations of the dust content of the atmosphere during balloon flights*

Date	Time	Location	Height above ground	Dust content, particles per c. c.	Remarks
		FREE-BALLOON DETERMINATIONS			
1924			*Feet*		
Apr. 1	4:45 p. m.	Scott Field	0	798	
	5:35 p. m.	Near Scott Field	1,050	(1)	
	6:25 p. m.		1,900	101	
	6:52 p. m.	Over Nashville, Ill	3,000	38	
	8:00 p. m.	Over Mt. Vernon, Ill	4,000	28	Large particles like spores.
	8:50 p. m.	Over Wayne City, Ill	5,100	(1)	
	9:06 p. m.	Over Mill Shoals, Ill	5,950	16	
	9:39 p. m.		7,000	9	
2	12:30 p. m.	Over Augusta, Ga	6,800	16	
	1:30 p. m.		6,000	(1)	
	1:50 p. m.		5,000	19	
	2:25 p. m.	Waltersboro, S. C	4,000	22	
11	3:45 p. m.	Near St. Jacob, Ill	2,600	36	
12	7:00 a. m.	Near Wasepi, Mich	2,000	41	
	9:05 a. m.	Over Jackson, Mich	4,000	59	
	11:10 a. m.	4 miles W. Detroit	3,500	57	
	11:40 a. m.	Over Detroit, Mich	1,000	152	
	12:35 p. m.	Over St. Claire Lake	4,100	23	
18	7:50 p. m.	4 miles NNE. Mascoutah, Ill	1,300	69	
	8:05 p. m.		2,500	24	
	8:35 p. m.		3,700	13	
	9:15 p. m.	SW. Mt. Vernon, Ill	4,800	38	
23	6:10 p. m.	E. Wanda, Ill	1,500	76	
24	6:40 a. m.	Over Lake Michigan	1,500	71	
	1:45 p. m.	3 miles SE. Black Creek	1,800	55	
29	3:20 p. m.	2 miles NNE. Lebanon, Ill	3,000	44	
	3:40 p. m.	4 miles SSE. Troy, Ill	4,100	40	
May 7	5:14 p. m.	4 miles SE. Scott Field	2,200	69	
	5:25 p. m.	1 mile S. Mascoutah, Ill	3,000	48	
	5:52 p. m.	Above clouds	4,300	16	
	6:14 p. m.	Above clouds	5,200		Cover glass broken.
	6:40 p. m.	Above clouds	6,200	12	
	7:00 p. m.	Above clouds	6,800	(2)	
		DIRIGIBLE DETERMINATIONS			
Apr. 28	10:00 a. m.	1 mile W. Scott Field	600	35	
		2 miles NE. Belleville, Ill	550	95	
		2 miles W. Belleville, Ill	550	72	
		1 mile S. Country Club	600	117	
	to	5 miles W. East St. Louis	600	108	
		5 miles W. Free Bridge	500	60	
		2 miles W. Free Bridge	500	44	
	11:00 a. m.	3 miles W. Belleville	500	38	
	11:45 a. m.	2 miles W. hangar	400	76	
	Noon	1 mile SW. hangar	300	98	
		SCOTT FIELD DETERMINATIONS			
Mar. 31	3:45 p. m.	Scott Field	0	522	
Apr. 7	2:00 p. m.	Scott Field	0	142	
8	10:00 a. m.	Scott Field	0	303	White sky.
9	9:30 a. m.	Scott Field	0	112	
10	11:30 a. m.	Scott Field	0	192	

[1] No visible record. [2] Less than 10.

Table 5 gives the time, place, and height above ground at which dust determinations were made. Table 6 summarizes the results.

TABLE 6.—*Summary of atmospheric dust determinations from balloons*

Height in feet	Number of determinations	Dust particles per c.c.			Remarks
		Mean	Max.	Min.	
Between 5,950 and 7,000	5	13	16	9	Free balloon.
Between 3,700 and 5,000	9	29	59	13	Do.
Between 2,000 and 3,500	8	45	69	24	Do.
Between 1,300 and 1,900	5	74	101	55	Do.
1,000	1	152			Free balloon over Detroit.
Between 300 and 600	10	74	117	35	Dirigible balloon.
Surface	6	345	798	112	At Scott Field.

These determinations show considerably less dust in the atmosphere than was found by Mr. Hand during airplane flights. This is partly explained by the fact that the balloon flights were made in the spring when we would expect less dust in the atmosphere than late in the season after convection has been adding to the dust at high levels for a long period. Further, it was suspected that some of the dust found during airplane flights came from the engine exhaust. We must therefore conclude that in the open country under normal conditions the dust content of the atmosphere is small above an altitude of 2,000 feet from the surface.

On April 12 the influence of smoke from the city of Detroit is apparent at elevations up to 3,500 feet.

CHARACTER OF THE DUST PARTICLES

Finely divided mineral matter, probably dust taken up from the surface of the ground by the wind, predominates in summer, with occasionally a few spores. These latter were observed at intervals from July 12 to November 21, in 1924, the maximum number being 20 per 1,000 cubic centimeters on August 29. In 1925 they were first observed on June 8. During the winter and especially on mornings with little wind, or with wind from an easterly direction, products of combustion may predominate. These latter are usually larger than surface dust particles.

HIGH MAXIMUM TEMPERATURES IN LATE SPRING OF 1925

By ALFRED J. HENRY

Following the warm winter of 1924–25, especially the month of February, it would not be surprising had there been more or less frequent short periods of unseasonably low temperature and blustery weather in the spring. In Europe such periods did occur, but here in the United States March as a whole was warm. April also was warm and especially characterized by a two-day period of abnormally high temperature when the daily maximum rose to 93° and 94° respectively. The average maximum temperature for April in Washington, D. C., is 63°. Residents of the United States east of the Rocky Mountains, and more especially those who live in Atlantic seaboard States, may recall that once every so often an outburst of summer heat is experienced sometimes as early as April. The April maximum temperature in Washington, D. C., has equaled or exceeded 90° in 5 out of the last 55 years, or 1 year in 11. For May with a mean maximum of 75° the maximum temperature has equaled or exceeded 95° in 6 out of the last 55 years and the highest maximum in that period, 97°, was recorded on May 23 of the present year.

These outbursts are considered as an integral part of the climate of the eastern two-thirds of the United States. They result from an apparently fortuitous combination of at least three basic initial conditions, as follows:

(1) The presence of an anticyclone over the eastern seaboard of the United States, with little or no movement except a slow settling to the southward.

(2) The presence of a cyclone west of the Mississippi, with a slow movement toward the east-northeast.

(3) Small net loss of heat from the earth's surface due to the presence of haze or light cirrus clouds.

When on any day in spring the two items first named are in combination the conditions are ideal for a rapid surface warming over the great interior valleys of the United States. The winds on the west margin of the anticyclone will be southerly, and although they may not necessarily be warm in the beginning they will soon become so. The change to higher temperature is not, as might be expected, uniform and coterminous with the area of the southerly winds, but rather it is localized in certain areas which appear to have a rather definite relation to

the center of the western cyclone; thus with a cyclone centered over Montana the area of high temperature will be found to the east or southeast, and this latter has a definite progression toward the east. The fact that these regions of high temperature begin in the west and progress to the east in harmony with the movement of cyclones appears to be conclusive evidence of their terrestrial origin.

Atmospheric temperatures depend on the balance between incoming solar radiation and outgoing radiation both from the air itself and the earth; hence in any discussion of temperature changes account should be taken of the sky conditions, especially with respect to outgoing radiation.

The changes of temperature here considered are the simple differences between the successive 8 a. m. (75th meridian time) observed temperatures with the appropriate algebraic sign prefixed.

Paradoxical as it may seem, outgoing radiation under one set of conditions will tend to depress the temperature and under a different set of conditions will tend to elevate it. It is with the latter that we are here chiefly concerned. As a result of impeded outgoing radiation on any night the nocturnal minimum will not be so low as with radiation to a clear sky. The amount of the elevation of the minimum is of course proportional to the amount of decrease in the outgoing radiation, but it may and does amount to as much as 10° F. When the night minimum is elevated by that amount the daily upward march of temperature starts at a higher level than otherwise would be the case and the maximum is of course higher.

On the morning of April 23, 1925, the minimum temperature at Washington, D. C., was 53°. The afternoon maximum on that date was 93° or a rise of 40° from the night minimum of the preceding 24 hours. On the next day the minimum was 62°, and this was followed by a maximum of 94°, or a range of 32° as against 40° on the preceding day. A search into the cause of the high maximum of the 23d will now be made.

On April 23 there were heavy clouds until 10 a. m., light clouds until 2 p. m., a sprinkle of rain from 7:20 to 7:30 and again from 8:45 to 8:50 a. m. The relative humidity was moderately high and the winds were from the south and southwest most of the day. A measurement of solar radiation made at Washington at noon on April 24 gave only 70 per cent of clear sky intensity. On this day, it may be remembered, the range in temperature was not so great as on the preceding day.

I therefore conclude that the April hot spell was due to the prevalence of southerly winds at a time when outgoing as well as incoming radiation was less than usual. This hot spell was brought to a close on the 24th by rain and a shift of the wind to easterly.

The high temperatures of May 21–24 were originally due to the prevalence of southerly winds over the great interior valleys from the 20th to the 23d. These winds were induced by a cyclone which moved from Alberta to the mouth of the St. Lawrence during the four days, May 18–21.

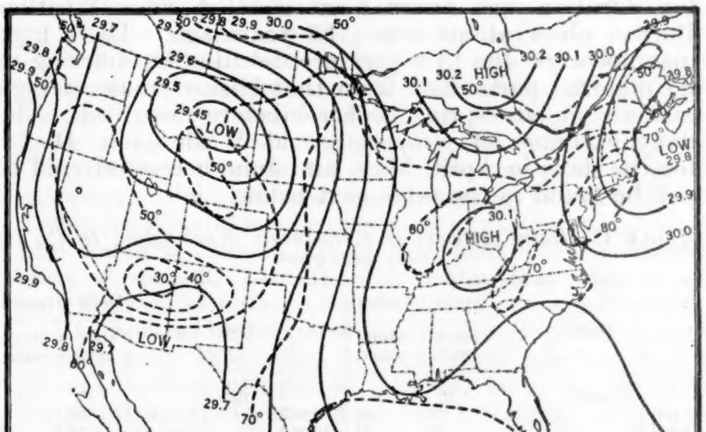
This cyclone was not followed by colder weather in its rear for reasons that are unknown. Possibly due to the fact that large masses of warm air persisted in its rear, it was followed almost immediately by a fresh cyclone which appeared on the Weather Bureau maps of the 22d over North Dakota, moved to the Lake Region by the morning of the 23d and was thence displaced to the southeast and eventually over the Atlantic by a strong anticyclone that first appeared on the map of the 23d.

This cyclonic disturbance was remarkable in several respects; its form was that of a long narrow oval that stretched west-northwestward from western Lake Erie to Minnesota with lowest pressure, 29.46 inches, in that State. It might easily be considered as an east-west trough of low pressure banked on its north by cold air and on its south side by extraordinarily warm air for the season. Thus at Canton in northern New York the 8 a. m. temperature on May 23 was 32° while at Binghamton in the southern part, only about 160 miles distant, the temperature at the same moment was 78° and this great contrast in temperature extended westward into the Upper Great Lakes region.

Such a temperature distribution is of course unstable. The colder northern air naturally gravitated southward and as a result the trough of low pressure was displaced to the southeast as previously stated. Equilibrium of temperature on the two sides of the disturbance was restored during the ensuing 24–36 hours, and this was accomplished without the occurrence of extraordinary climatic phenomena, if we except the very severe hailstorm at Baltimore, Md., as elsewhere described in this Review, p. 261. This storm was undoubtedly due to the great north-south temperature contrasts on May 24, 1925. Doubtless many other hailstorms, of which no notice has come to hand, occurred on the same date.

Snow fell in the upper Great Lakes region, and the hot spell in the East was terminated by rains on May 24.

In conclusion I may point out that while the general type of pressure distribution that brings about large abnormalities in temperature already has been indicated (items 1 and 2), yet it is the small day-to-day pressure variations superposed upon the more or less stable formation (the western extension of the Azores HIGH over the southeastern States is meant) which in the final analysis are the immediate and direct cause of large departures from normal temperature. As illustrating one of the many modifications of the general type, I present herewith a reduced copy of the weather chart for June 21, 1923, a day on which the maximum temperature in Washington, D. C., was 98°, Baltimore and Philadelphia, 100° each, New York, 94°, Boston, 96°, and Atlantic City, 90°.



June 21, 1923. -- 8 a.m.

Modifications of the general type are chiefly brought about by the movement of cyclonic systems eastward down the St. Lawrence Valley. Many of these systems already have reached the dying stage, and therefore have but little influence upon the general pressure distribution, but occasionally a vigorous cyclone comes along, or more specifically a moderate cyclone develops much intensity as it approaches the eastern seaboard. It is not known

why this increase in intensity should take place. The forecaster must of necessity await until the development has actually taken place before he can utilize the information thereby afforded. I mention this fact because of its bearing on long-range forecasting, a subject which at present is very much in the forefront.

The weather chart here presented differs only in detail from the ordinary hot weather type for early summer. On this chart the extreme western projection of the western North Atlantic anticyclone has been detached from the main oceanic area by a fall in pressure incident to the eastward movement of the cyclone that is centered off the Maine coast. As a result of this separation the inland HIGH over the upper Ohio Valley has set up an independent wind circulation—north to east winds on its right margin and southerly winds on its left margin. This circulation, however, had no effect on the general level of the temperature within its sphere of influence. The temperature at the time the chart was made happened to be close to the eighties from the middle Mississippi Valley eastward to the Atlantic. An illustration of a sharp rise in temperature with north and northwest winds may be found in the region on the east border of the HIGH. At Washington, D. C., temperature rose from 81° at 8 a. m. to 97° at 5 p. m., with continuous light north and northwest winds.

Inspection of the chart will show that the temperature was above 70° over practically the whole area east of the 100th meridian and south of the 45th parallel. The hot weather that had set in on June 18 continued until the 28th, and it was brought to a close by a cyclonic disturbance that developed over Nevada on the 23d, increased greatly in intensity while passing down the St. Lawrence Valley on the 27th, and thus created a barometric gradient for northerly winds which effectively lowered the temperature in Atlantic seaboard districts. And this is merely another case of the inability of the forecaster to read the daily weather chart beyond a few days in the immediate future.

The June, 1925, warm spell.[3]—The foregoing was written during the prevalance of a period of high maximum temperatures in the Middle Atlantic States that for duration has never been equaled since Weather Bureau observations began 55 years ago. These high maxima were due to a pressure distribution differing in no material particulars from that characteristic of high maxima in late spring as hereinbefore described. The daily extremes of temperature at Washington, D. C., for the days in April, May, and June herein referred to will be found in the table next below.

TABLE 1.—*Daily extremes in temperature Washington, D. C., for the days given*

Date	Daily extremes: Maximum	Daily extremes: Minimum	Date	Daily extremes: Maximum	Daily extremes: Minimum
1925	° F.	° F.	1925	° F.	° F.
April 23	93	62	June 3	99	71
April 24	94	54	June 4	99	73
May 23	97	60	June 5	100	71
May 24	90	48	June 6	97	74
June 1	94	59	June 7	94	73
June 2	97	65	June 8	93	72

[3] Nature, London, June 20, 1925, gives a brief account of a warm spell in England, especially in southern and midland districts. The period of high temperatures began June 3 and continued at least until the 11th. One wonders whether the near approach to synchronism in both the United States and England was purely fortuitous.—*Ed*,

Since the foregoing was written Mr. R. M. Dole, of the Lansing, Mich., station, has contributed a few notes on the hot weather in June, 1923 and 1925, respectively. These notes, pertaining as they do to free air movements, are of very considerable interest and are here reproduced.

In such stagnations [times of westward extension of North Atlantic high over the continent] the upper clouds have been repeatedly observed to be moving very slowly in their normal directions or from abnormal directions. In the June, 1923, heat wave the upper clouds were observed to be moving very slowly from some westerly direction, while in the June, 1925, heat wave the upper clouds were observed on several occasions to be moving from east, southeast, and south very slowly. The 1923 heat wave was accompanied by soaking thunderstorms, while in 1925 there was a drought. It has been observed in other droughts that the upper clouds were moving from some easterly direction.

It was to be expected that free-air observation by balloons would confirm the fact that the air movement aloft was much lighter than the normal, thus contributing to a super heating. Several free-air balloon flights were selected during these heat periods and tabulated. The figures conclusively show that the air movement is light aloft as shown by the slow movement of the upper clouds. The average movement of free air for summer was worked out for Lansing by Mr. C. L. Ray up to the 6,000 m. level and the levels higher are extrapolated. In the six flights it will be noticed that the wind movement tends to become lighter the higher the level, confirming the observations of the slow movement of the upper clouds and the suspected stagnation.

TABLE 2.—*Wind movement in meters per second and the levels in meters during hot spells in June, 1923 and 1925, respectively*

Year 1925: June 5	Year 1925: June 6	Year 1925: June 7	Levels (meters)	Year 1923: June 17	Year 1923: June 22	Year 1923: June 23	Year 1923: Normal
Wind movement in m. p. s.				Wind movement in m. p. s.			
13	7	7	500	6	4	1	6
1	5	8	1,000	2	3	3	6
9	7	6	1,500	4	2	6	7
9	4	5	2,000	2	2	7	8
9	8	6	2,500	4	4	6	8
10	12	6	3,000	7	5	4	9
8	6	5	3,500	5	5	6	10
8	9		4,000	5	5	6	10
5	4		4,500	5	3	3	10
	3		5,000	5	2	3	11
	2		5,500	4	6	2	(11)
	2		6,000	5	6	2	12
	2		6,500	6	5	2	(12)
	5		7,000	7	4	2	(13)
	5		7,500	5	4	2	(13)
			8,000	5	4	2	(14)
			8,500		4		(14)
			9,000		4		(15)
			9,500		5		(15)

CLOUD OBSERVATIONS

Ci. w. mod.	Ci. Cu. se. slow.	Ci. Cu. A. cu. A. st. s. se. se. slow.		Ci. sw. slow.	A. cu. w. slow.	Ci. nw. slow.	

NOTE.—"Normal" values in parenthesis are estimated by extrapolation,

MONTHLY FORECASTS BY CORRELATION

JUNE, A KEY MONTH

By CHARLES D. REED

[Weather Bureau Office, Des Moines, Iowa, July 9, 1925]

In Iowa as June mean temperature goes so goes the temperature of the next three months. For the 35 years of State-wide records, ending with 1924, the correlation coefficient of the mean temperature of June with the combined mean temperature of July, August, and September is 0.559 ± 0.078. Expressing this in a regression formula for prediction purposes, it takes the form

$$Y = .34X + 46.37$$

in which X is the mean temperature of the current month of June and Y is the predicted mean temperature of the three following months combined.

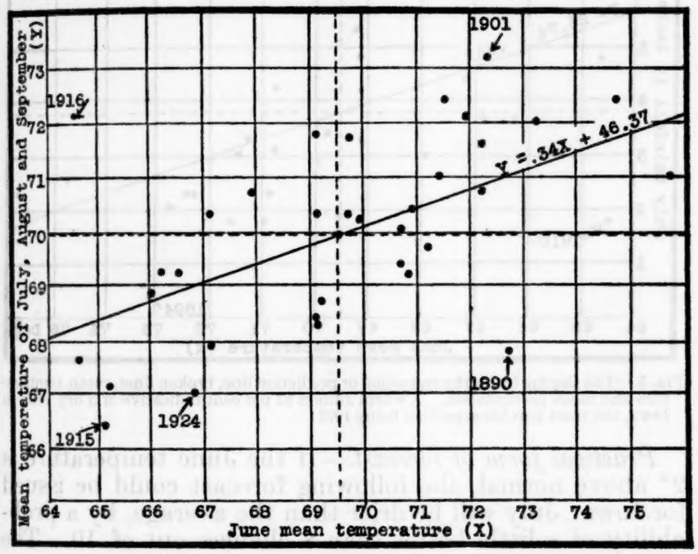


FIG. 1.—June temperature indicates the temperature of the next three months, as shown by the sloping regression or prediction line. Broken lines show mean temperatures. Years that depart most widely connected with dots by arrows

The dispersion of the data can best be visualized by an inspection of Figure 1. It will be observed that there is a fairly well defined arrangement of the data along the regression line. As is usual in such cases, it is much easier and sufficiently accurate to read the prediction from the coordinates instead of computing it by the formula, though the regression line could not, of course, be accurately located in the first place without the necessary mathematical process. Its meaning is that if the formula $Y = .34X + 46.37$ be applied to the prediction of the temperature of each three-month period and the average error determined, the error will be smaller than could be obtained by any other line or formula. Inspection of Figure 1 gives the impression that no curvilinear formula could be devised that would be superior. As a matter of fact, the average error in the 35 cases under consideration is $\pm 1.1°$. The greatest error would have been $-3.8°$ in 1916 and there are two cases, 1915 and 1917, when the error would have been zero.

The error in the temperature predicted by this formula would, in 35 years, have equaled or exceeded 1.5° 10 times, 2.0° only 5 times, 3.0° but twice, and never would have exceeded 3.8°. The probable accuracy is made more apparent in Figure 2, where the actual data, limited to the 35 cases, are expressed in percentage, dotted in, and a smooth curve drawn to indicate the probable accuracy of a large number of cases.

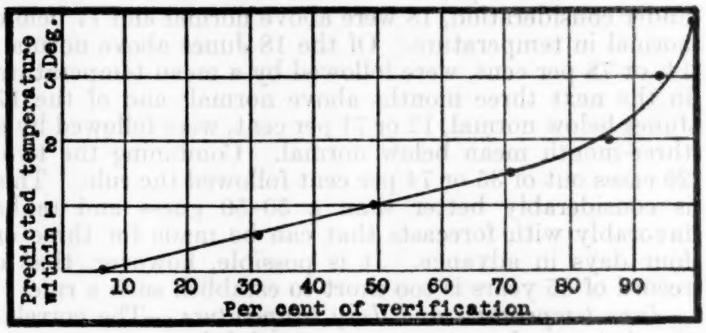


FIG. 2.—Per cent of accuracy for each limiting degree in the prediction; e. g., the prediction will be accurate within 1.5°, 71 per cent of the time

Notable exceptions.—The years that departed most widely from the formula have, for convenient reference, been noted on Figure 1. In the year 1916 some very unusual influence seems to have depressed the temperature in June to the lowest of record and far below the point indicated by correlations with various other meteorological elements. Whatever this influence was, it affected about 90 per cent of the area of the North American continent, and it disappeared abruptly in the closing days of June, so that the following July in Iowa is next to the warmest of record. The mean of the three months, July, August, and September, working the formula backwards, indicates that June should have had a mean of 75.7° instead of 64.5°, the lowest June mean of record in Iowa. The predicted temperature would have been 3.8° too high which is the greatest error in the series. Any influence so strong and with such sharply defined time limits ought to be easily traced. Kimball[3] states that data from American stations showed a noticeable depression in the intensity of solar radiation measured at the earth's surface in 1916–17, and the dots on his graph show a marked decline about June, though more general reports from the Northern Hemisphere received later were not in harmony with the American data.[4] This influence seems to have been peculiar to North America. Volcanic dust could scarcely account for the freak, for it could not be dispersed so rapidly as to permit the following month to become next to the warmest July of record. Nor has this writer been able to find any account of notable volcanic activity near that time.

The next widest departure from the predicted temperature was in 1890, when a warm June was followed by a cool three-month period. In this case, the predicted temperature would have been 3.3° too high.

In the abnormally hot season of 1901, June temperature indicated the hot weather to follow, but the predicted fell short of the actual temperature by 2.2°. As this was the warmest three months (July, August, and September) of record, the formula could not be expected to go all the way. Similarly, the cool June of 1915 indicated the cool season to follow, but lacked 2.1° of going all the way in the coolest three months following.

[3] MONTHLY WEATHER REVIEW, August, 1918, 46: 356.
[4] MONTHLY WEATHER REVIEW, November 1924, 52: 528.

Likewise the cool season of 1924 was indicated by the cool June, but the predicted lacked 2.1° of being as low as the actual. Each of these freak years offers an interesting problem for further study.

Frequency.—While the foregoing presents the quantitative relationship with mathematical accuracy, a simpler and very interesting study was also made of the frequency with which the rule expressed in the opening sentence of this paper was followed. Of the 35 Junes under consideration, 18 were above normal and 17 below normal in temperature. Of the 18 Junes above normal, 14, or 78 per cent, were followed by a mean temperature in the next three months above normal; and of the 17 Junes below normal, 12 or 71 per cent, were followed by a three-month mean below normal. Combining the two, 26 cases out of 35 or 74 per cent followed the rule. This is considerably better than a 50–50 guess and ranks favorably with forecasts that can be made for three or four days in advance. It is possible, however, that a record of 35 years is too short to establish such a rule.

June temperature and July temperature.—The correlation between June temperature and July temperature in Iowa is 0.394 ± 0.096 and the regression formula for predicting July temperature from June temperature is

$$Y = 0.4X + 46.2$$

in which Y is the July temperature required and X is the temperature of the preceding June. The correlation coefficient is not as large as in the case of June temperature with July, August, and September temperatures combined; and the frequency with which June temperature departures are in the same direction as July departures is somewhat smaller. June temperatures were above normal 18 out of 35 times. Ten of these 18, or 56 per cent, were followed by warm Julys. June was below normal 17 times and 12 of the 17, or 71 per cent, were followed by cool Julys. Combining these, 22 out of 35, or 63 per cent, followed the principle that July departures tend to follow June departures.

June temperature indicates July rainfall.—The correlation of June temperature with July rainfall in Iowa is -0.486 ± 0.087. The regression formula is

$$Y = 26.74 - .33X$$

in which Y is the required rainfall of July in inches and X is the mean temperature of the preceding June in degrees Fahrenheit. Though the correlation coefficient is not large, due to a rather wide dispersion of the data (see fig. 3), and the quantitative relationship necessarily shows discrepancies between predicted and actual amounts, dry Julys follow warm Junes with remarkable frequency. Of the 18 Junes with temperatures above normal, 15, or 83 per cent, were followed by deficient rainfall in July, averaging about a third of an inch deficiency for each excess degree of June temperature. When the June temperature was below normal it indicated July rainfall above normal only 9 out of 17 times, or 53 per cent, and is therefore of no value. However, for each degree June temperature is below normal July precipitation averages about a third of an inch above normal.

Here again the June, 1916, temperature seems unaccountably low, and the strange thing is that if the temperature of June, 1916, be taken as 75.7°, as the purely temperature correlations indicated it should have been, as before mentioned, it would have indicated 1.76 inches of rainfall in July following, while the actual amount was 1.78 inches. This is further proof of some temporary, powerful, and unusual influence that depressed surface temperatures far below what they should have been in June, 1916. From what has gone before it is a corrollary that if July is warm it is also dry, and if it is cool it is also wet. The correlation coefficient expressing this fact is -0.502, which harmonizes nicely with the general proposition. For the 18 cases when June temperatures were above normal the formula would have predicted the rainfall of July within 0.5 inch half of the time; within 1.0 inch 72 per cent of the time; within 1.5 inches 83 per cent, etc.

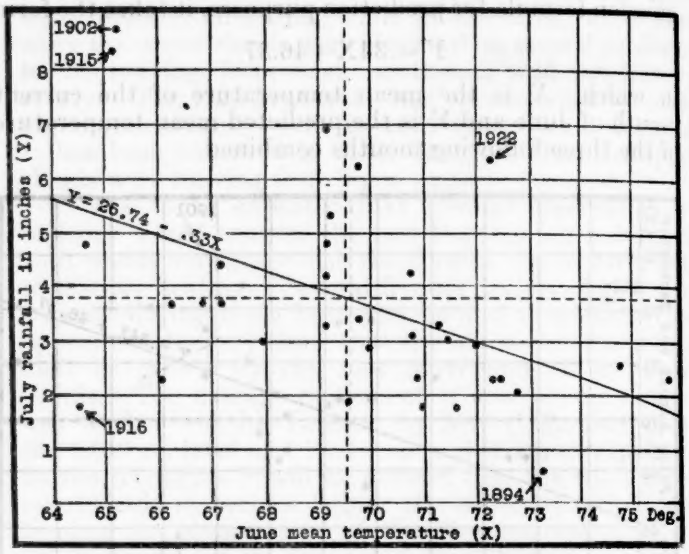


FIG. 3.—The sloping line is the regression or prediction line; broken lines, mean temperature and mean precipitation. A warm June is 83 per cent indicative or a dry July in Iowa, the most notable exception being 1922

Practical form of forecast.—If the June temperature is 2° above normal, the following forecast could be issued for Iowa: July will be drier than the average, by a probability of a little better than 8 chances out of 10. The indicated rainfall is about 3.1 inches, while the average for the last 35 years is about 3.8 inches. The chances that the rainfall will not be greater than 4.1 inches nor less than 2.1 inches are better than 8 out of 10. The chances that July will be warmer than the average are about 6 out of 10; but the temperature will probably be less than a degree above the average.

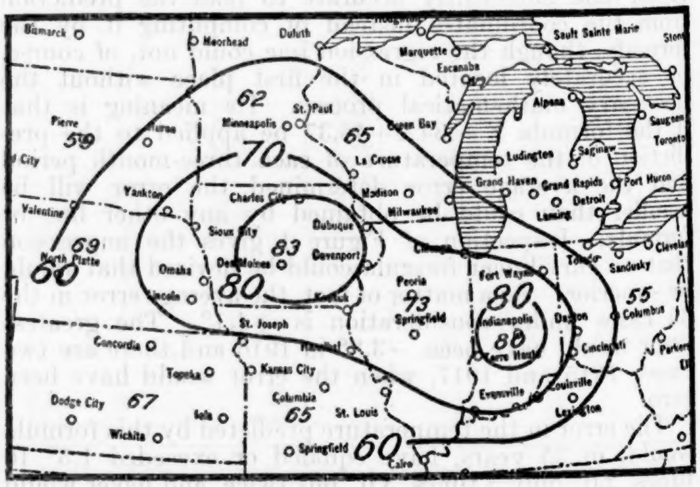
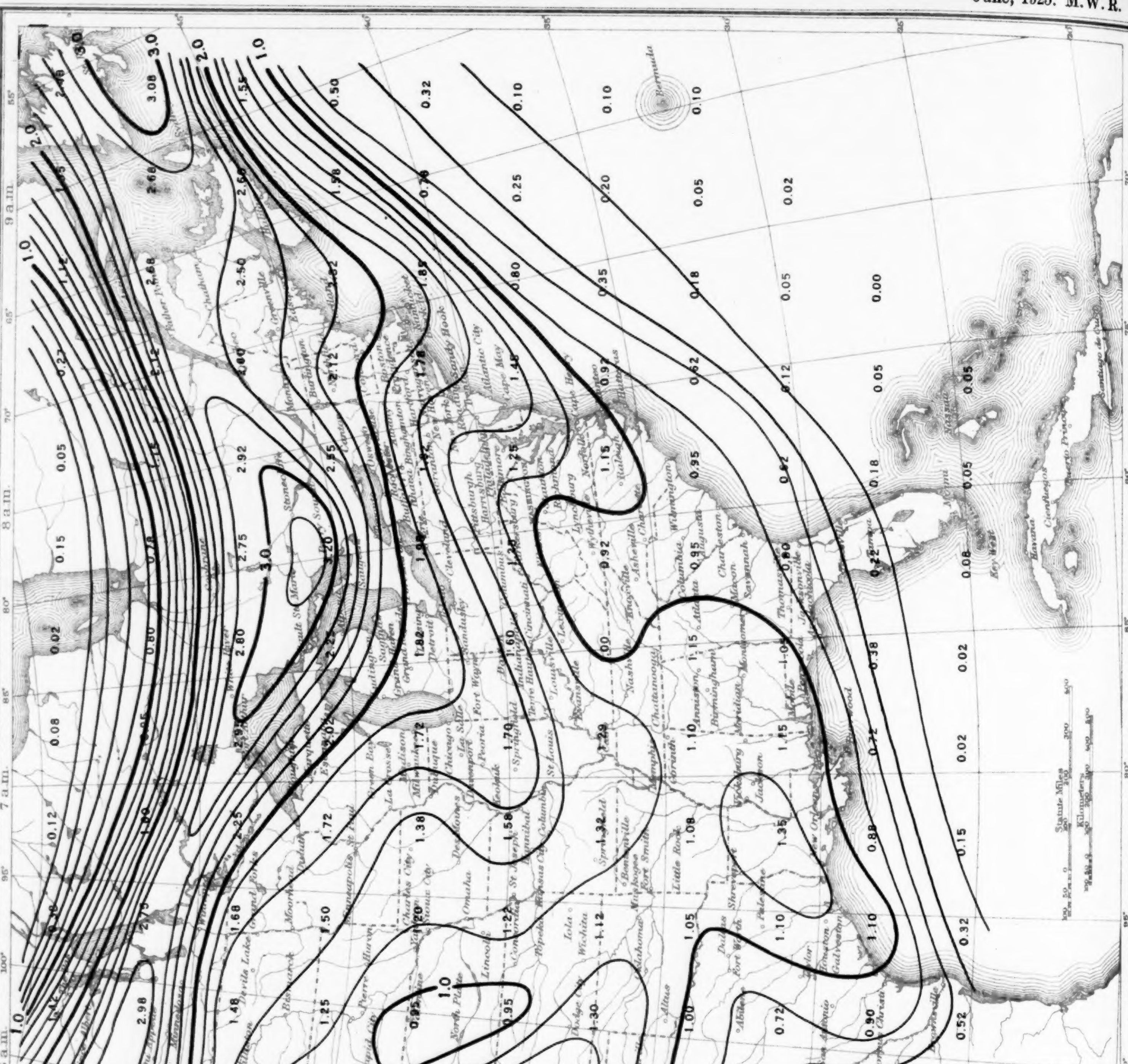


FIG. 4.—Figures near the center of each State show the percentage frequency that dry Julys follow warm Junes

The average temperature of the next three months, July, August, and September, combined will probably be



K. K. Fig. 2. Isoclones for the United States, January

above normal, the chances being nearly 8 out of 10. The indicated average of the next three months is about 70.7°, which is 0.7° above normal.

Will this apply elsewhere?—The percentage of frequency that warm Junes are followed by dry Julys has been worked out for near-by States. These percentages appear on the small map, Figure 4. From Iowa to Indiana the chances of verification are better than 7 out of 10, but outside of this the percentage diminishes in regular zones. The verification is somewhat greater by State areas than by individual stations.

Practical applications.—When the end of a cool June has been reached without business activity in warm weather goods, such as palm beach suits, straw hats, bathing suits, electric fans, ice cream, soft drinks, etc,. the merchant wonders if June is a sample of the rest of the season. He could be advised that the chances were better than 7 out of 10 that July and also the next three months would average below normal in temperature. He could than take steps to unload stocks or contract rather than expand his business. His policies and the character of his advertising would be entirely different. Or if June is warm, warm weather enterprises, such as bathing beaches, amusement parks, and water-front real estate, could put on full speed ahead with the assurance that they had nearly 8 chances out of 10 of having a good run of business in the next three months.

Sarle has shown that the merchantability of Iowa corn is more largely determined by June temperature than by any other factor. If June is warm, it is almost safe to assert that very little of the corn will be frosted or immature. There is almost no correlation between merchantability and date of first killing frost in autumn, strange as this may seem, for the real damage is done, or advantage gained, in June.

The relationship between June temperature and corn yield is complicated by so many factors that it can not be expressed by simple correlation. However, the factors can be separated and measured, as this writer hopes to show in a future paper. It is sufficient to say at this time that a warm June produces luxuriant corn plants that are rated at a high percentage condition by crop reporters on July 1. What happens to the corn later on is not a fault in the structure of the plants, but is almost wholly due to the fact that more than 8 times out of 10 a warm June is followed by a dry July, and if dry it is most likely hot, as was shown in the first part of this paper. This cuts the yield but improves the merchantability as a rule.

Other correlations.—No other such large, simple correlations have been found, though nearly 300 have been worked out by computing-machine[5] methods. In a general way a regression formula coming from a correlation smaller than ± 0.30 will not give a prediction much better than guess work, yet by the method of partial correlation the indications of several previous months make it possible to say with an accuracy much better than guess work whether or not the month just ahead will be drier, wetter, warmer, or cooler than normal.

[5] "Correlation and Machine Calculation," Wallace and Snedecor, Iowa State College of Agriculture and Mechanic Arts, Official Publication, Vol. 23; No. 35; January 28, 1925.

A NEW METHOD OF CHARTING STORM FREQUENCY

By Keith Kelsey
[Grand Central Terminal, New York City]

The usual method employed by meteorologists to indicate graphically the storminess of a given area is to plot on a map the number of cyclone centers crossing each 5° square in that area and then to draw lines through points of equal storminess. This method has several disadvantages:

The area of a 5° square in the vicinity of Tampa is, roughly, 30 per cent, or 24,000 square miles greater than the area of one near Duluth.

A chart of isoclones[6] on this basis is thus distorted in favor of the southerly latitudes in the Northern Hemisphere.

"The number of barometric minima per month passing through the 5° square surrounding Duluth" does not convey as clear a conception of conditions as does the more rational and apposite expression, "the number of barometric minima per month passing within 200 miles of Duluth."

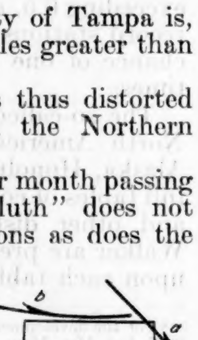


Fig. 1

A cyclone cutting the corner of the 5° square surrounding Duluth is counted for that city, while one moving due eastward 30 miles closer (*b*, fig. 1) or one passing due southward 85 miles closer (*c*, fig. 1) would not be so counted.

The 5° square is too large a unit to allow the chart to show to any considerable degree the effect of land and water areas upon cyclone paths.

A unit of area that does not involve these objections is a circle 400 miles in diameter. The shape of this unit gives equal weight to each storm regardless of its direction of travel or its latitude, while the size of the unit is such that sufficient data for good interpolation for an area the size of the United States are obtained.

The accompanying isoclonic chart was prepared using a circle of 400 miles diameter as the unit. The isoclones give the average number of cyclones passing within 200 miles of a given locality during the month of January. The necessary data were obtained from the track charts of the Monthly Weather Review for the 40 Januarys, 1892 to 1921.

Tangent circles of 200 mile radius were carefully drawn on sheets of onion-skin paper the size of the track charts. Latitude and longitude register marks were drawn on these sheets so that when each was oriented on a track chart the centers of the tangent circles would be in the same geographical localities in every case. Cyclone track charts from 1885 to 1890 were on such a projection as to necessitate the use of ellipses to represent the circles of charts of other years.

One such prepared sheet of onion-skin paper was then clipped onto a cyclone chart with precise adjustment of the register marks. Next taking each storm track in order by number, all the cyclones were followed across the chart, a dot being placed within each circle crossed by the storm path. This same onion-skin sheet was used for 10 Januarys and when all the storm tracks of those 10 months were checked off the dots in each circle were totaled.

Upon the completion of four of these circled charts the figures in corresponding circles were added and the totals divided by 40 giving the average number of paths

[6] Contraction of isocyclone.

crossing each circle during the month of January or in other words the number of cyclones passing within 200 miles of the centers of the circles.

These average figures were then plotted upon a blank map at the centers of their corresponding circles. By interpolation, isoclones were drawn permitting values to be read for localities other than those at the centers of the construction circles.

Both individually and in comparison with others this isoclonic chart shows several interesting facts.

The influence of land and water on the place-frequency of storms is apparent from the shapes of the isoclones.

In the Pacific Coast Region the normal southeasterly trend of the isoclones is distorted by the prevalence of stagnant HIGHS in the dry, cold Plateau Region. That the majority of the North Pacific LOWS are forced to enter the continent at high latitudes and to move due east until the Rocky Mountains are crossed before turning southeastward, is plainly indicated by the chart.

In the lee of the Rockies the origin of the Colorado LOWS is evidenced by a well defined isoclonic maximum. The source of Texas LOWS is likewise clearly indicated.

The marked southerly trend of the isoclones in the Mississippi Valley is probably due to a number of causes, such as increased moisture supply, flat topography, and the closing together of the paths of South Pacific, Colorado, and Texas LOWS. The high maximum over the Great Lakes is due again chiefly to moisture supply, flat topography, the confluence of many storm paths, and, in addition, to the southward pressing effect of the Hudson Bay HIGH.

The presence of the Appalachian System is shown by the isoclonic minimum in that region. Further eastward the Atlantic Ocean causes a southerly dip in the isoclones before they are pushed to the north by the Bermuda HIGH.

A minor juncture of storm paths is marked by an isoclonic maximum off Newfoundland.

The steep gradient between Hudson Bay and the Great Lakes is probably more apparent than real. The use of Canadian Weather Service maps would no doubt have modified the chart in that locality.

In conclusion it may be pointed out that this type of chart, as well as being of general climatic interest, is of particular value, due to its construction, in investigations of the effects of cyclonic frequency upon health and human efficiency.

CORRELATION IN SEASONAL VARIATIONS OF WEATHER—A FURTHER STUDY OF WORLD WEATHER [7]

By GILBERT T. WALKER

[Abstracted by A. J. Henry]

This paper is a continuation of the series, Correlation in Seasonal Variations of Weather, begun in Part IV of volume 24 of the Indian Meteorological Memoirs. In that paper Doctor Walker presented the results of a preliminary study of the relationships between 17 centers of action of which 15 were centers for pressure and 2 for rainfall.

Since the publication of the memoir just mentioned the survey of the relationships has been carried a step farther, and the author now presents data of relationships for the entire year, whereas in the earlier publication the data were applicable only to summer and winter.

The number of years of data for the several centers of action is roughly 43 for the great majority of centers and but about 20 for Samoa and Alaska. In discussing the significance of correlation coefficients derived from records varying in length as indicated it is pointed out that the probable value of a correlation coefficient based on random data would be 0.151 and 0.103 for the long and short series, respectively.

In the Alaska or Samoa tables there will be found in the column for contemporary quarters 17 coefficients with other centers based on data of about 20 years; so that the probable value of the greatest of 17 random coefficients is 0.151×3.04 or 0.459.[8]

Two tables are presented in which the probability of a number of random coefficients exceeding certain limiting values (0.459 in the longer series and 0.305 in the shorter) is given. From these tables it is concluded that the probability of a random coefficient diminishes rapidly with growth in its size. It follows therefore for the short-period records of Alaska and Samoa that though it is as likely as not that one of the random coefficients will exceed 0.46 there is a chance of only about 1 in 3 of the greatest exceeding 0.5, 1 in 5 exceeding 0.55, 1 in 9 of exceeding 0.6, and 1 in 34 of exceeding 0.7. For the long record stations this feature is still more pronounced, the chance of one coefficient exceeding 0.6 is only 1 in 380 times.

The so-called centers of action of greatest interest to North American meteorologists are, perhaps, those of Alaska, Honolulu, and Charleston. For this reason the full tables of correlation coefficients between these centers and other distant centers as worked out by Doctor Walker are presented below. Doctor Walker's comment upon each table is also reproduced.

[7] Calcutta, Indian Meteorological Memoirs, 24, Part IX, pp. 275-332.

[8] For the development of this expression the reader is referred to Vol. XXI, Part IX, p. 15, Ind. Met. Mem.

ALASKA PRESSURE

	Years of data	December-February					March-May					Years of data	June-August					September-November				
		Two quarters before Alaska	One quarter before Alaska	Same quarter	One quarter after Alaska	Two quarters after Alaska	Two quarters before Alaska	One quarter before Alaska	Same quarter	One quarter after Alaska	Two quarters after Alaska		Two quarters before Alaska	One quarter before Alaska	Same quarter	One quarter after Alaska	Two quarters after Alaska	Two quarters before Alaska	One quarter before Alaska	Same quarter	One quarter after Alaska	Two quarters after Alaska
		J-A	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*		*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*
Iceland	21	+0.06	+0.42	-0.18	-0.12	+0.20	-0.10	+0.22	-0.20	+0.14	-0.22	22	0.00	+0.26	+0.56	+0.36	+0.26	+0.26	-0.26	+0.06	-0.30	-0.04
Alaska	22	+.04	+.24	+1.00	-.12	-.02	-.16	-.12	+1.00	-.12	-.54	23	-.02	-.12	+1.00	+.04	+.04	-.54	+.04	+1.00	+.24	-.16
C. Siberia	17	-.28	+.50	+.18	+.22	+.32	-.16	-.06	+.30	-.30	+.22	17	+.44	.00	+.28	-.52	-.24	-.06	-.08	-.08	.00	+.02
Vienna	17	-.06	-.06	-.36	-.36	+.12	+.24	-.06	-.24	.00	-.12	18	-.32	-.38	+.30	-.26	+.06	+.30	+.02	+.46	+.42	-.06
Azores	21	+.08	-.02	+.24	-.14	-.48	+.06	-.38	+.26	+.04	+.16	22	-.14	+.02	-.32	-.18	-.28	-.16	+.24	-.30	+.16	-.06
Charleston	20	.00	-.24	+.36	-.42	-.28	+.20	-.32	+.14	+.16	-.32	21	+.02	+.06	+.18	-.40	-.14	-.14	-.12	+.32	+.32	-.20
San Francisco	21	+.24	-.08	-.22	-.48	+.04	+.06	-.12	-.14	+.24	-.28	22	-.12	+.14	+.18	-.38	-.10	+.34	-.02	+.30	+.16	-.04
Tokio	18	-.02	-.18	-.22	-.02	+.10	+.22	.00	+.04	-.20	+.14	19	+.32	-.18	+.04	-.22	-.02	+.10	+.26	-.16	+.18	-.22
Cairo	18	+.08	+.36	-.28	-.26	+.12	-.08	-.24	.00	-.18	-.26	19	-.12	-.14	-.42	-.24	-.30	+.38	+.30	+.36	+.52	+.20
Honolulu	19	+.22	-.14	-.70	-.14	-.12	-.02	-.26	-.52	-.44	+.16	20	-.04	-.30	-.28	-.24	-.14	+.50	+.42	-.22	-.06	-.08
N. W. India	21	-.28	+.18	-.08	+.16	-.04	+.20	+.20	+.38	-.48	+.20	22	+.02	+.18	-.22	-.08	+.24	-.14	+.20	-.22	.00	+.02
Port Darwin	20	-.12	-.24	-.24	+.28	-.24	+.08	+.30	+.32	+.34	+.44	21	-.12	+.14	+.26	+.16	+.18	-.36	-.10	-.30	-.06	-.24
Mauritius	21	-.26	-.10	+.08	+.24	-.22	-.18	+.32	-.18	+.18	+.12	21	.00	+.26	+.22	-.22	-.24	+.18	+.08	-.08	-.22	+.20
Samoa	4	(+.4)	(+.1)	(-.2)	(-.1)	(-.2)	(-.5)	(-1.0)	(-.7)	(-.7)	(-1.0)	4	(+.1)	(-.5)	(-.4)	(+.2)	(-.4)	(+.2)	(+.4)	(+.9)	(+.4)	(+.7)
S. E. Australia	21	-.04	-.06	-.14	+.32	-.50	-.20	+.14	+.04	+.36	+.24	22	-.34	+.20	+.06	+.10	+.06	-.12	+.22	+.02	-.10	-.32
Cape	21	-.18	+.64	-.52	-.42	+.04	-.14	-.04	+.06	+.04	+.04	22	-.02	+.20	-.04	-.28	+.16	+.14	+.32	+.10	+.06	+.16
S. America	21	+.04	+.16	-.08	+.14	-.02	+.02	+.02	-.28	+.06	-.26	22	-.34	+.08	-.06	-.12	-.06	+.04	+.16	-.10	+.12	.00
Temperature																						
Dutch Harbor	18		+.62	+.68	+.04			+.22	+.48	-.46	+.08	19		-.12	+.12	+.24		-.56	+.10	.00	+.10	
Rain																						
Peninsula (J-S)	22	+.66				-.36				-.04		22			-.12				+.30			
Java (O-F)	19			+.34				-.02				19	+.06				-.08				-.04	

ALASKA PRESSURE

The coefficients with Samoa are inserted in brackets because there are only four years in which the series overlap. Of the contemporary winter coefficients two are about 0.7; that with Honolulu shows clearly the strong opposition between the areas of high and low pressure in the North Pacific, though at San Francisco and Tokyo this is but slightly marked, and the other that accentuation of the North Pacific low pressure leads to lower temperatures at Dutch Harbor on its northern margin. The coefficients with the Cape in the contemporary and previous quarters involve too much discontinuity for stations so far apart and are doubtful. Of coefficients of seasons separated by one quarter the only other one exceeding 0.52, the probable random greatest value, is Dutch Harbor and there the relationship is probably real.

In spring the same relations with Honolulu and Dutch Harbor persist; and the data of four years comparison with Samoa suggest that the opposition in the Pacific extends southwards across the equator.

In summer the area of low pressure has almost disappeared and the only probable contemporary relationship is one of sympathy with Iceland; the noncontemporary relationships are all uncertain.

In autumn the opposition with Honolulu has not yet developed, and the strong sympathy with Samoa which is suggested by the 4 years of comparison available is not supported by the previous or succeeding quarters. Of the noncontemporary coefficients the biggest of the two groups excluding Dutch Harbor have values of 0.50 and 0.52, practically identical with that produced by pure chance; these must therefore be ignored.

HONOLULU PRESSURE

	Years of data	December-February					March-May					Years of data	June-August					September-November				
		Two quarters before Honolulu	One quarter before Honolulu	Same quarter	One quarter after Honolulu	Two quarters after Honolulu	Two quarters before Honolulu	One quarter before Honolulu	Same quarter	One quarter after Honolulu	Two quarters after Honolulu		Two quarters before Honolulu	One quarter before Honolulu	Same quarter	One quarter after Honolulu	Two quarters after Honolulu	Two quarters before Honolulu	One quarter before Honolulu	Same quarter	One quarter after Honolulu	Two quarters after Honolulu
		J-A	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*		*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*
Iceland	37	0.00	-0.16	-0.18	-0.10	-0.04	+0.06	+0.06	-0.06	-0.16	+0.16	38	-0.06	+0.06	-0.34	-0.06	0.00	-0.10	[1] 0.20	-0.12	-0.20	-0.10
Alaska	19	-.14	-.06	-.70	-.26	-.04	-.08	-.14	-.52	-.30	+.50	20	-.12	-.44	-.28	+.42	+.22	+.16	-.24	-.22	-.14	-.02
C. Siberia	33	-.20	-.28	-.30	+.14	-.38	-.22	+.10	-.02	-.34	+.24	33	+.06	-.04	-.16	-.30	-.08	+.26	-.20	+.42	-.14	+.02
Vienna	35	-.20	+.08	-.04	+.10	-.14	-.10	-.14	+.18	-.40	+.08	35	+.10	+.12	-.26	+.12	+.10	+.16	-.03	-.02	-.04	+.26
Azores	38	+.16	-.14	+.14	+.16	+.20	-.34	-.06	-.14	+.06	-.14	38	+.08	-.24	+.20	+.14	-.08	-.04	-.04	+.20	-.02	-.02
Charleston	37	+.10	+.04	-.20	+.20	+.20	-.10	-.12	-.08	+.04	+.30	37	+.10	-.14	-.08	+.10	+.30	-.40	-.18	-.08	+.22	-.02
San Francisco	39	+.14	+.10	+.14	+.18	+.20	+.04	+.14	+.14	.00	+.40	39	+.04	+.22	+.14	+.36	+.08	-.32	+.02	+.26	+.02	+.10
Tokio	38	-.12	-.02	+.40	-.02	-.10	-.06	-.20	+.04	-.06	+.22	38	-.22	+.08	+.40	-.06	-.24	+.24	+.30	-.02	+.04	-.02
Cairo	36	+.18	-.02	+.20	+.34	+.10	-.20	-.10	+.28	+.08	+.18	36	-.12	-.06	-.06	+.14	-.28	.00	+.08	+.02	-.20	-.10
Honolulu	39	-.16	+.12	+1.00	+.44	+.12	.00	+.44	+1.00	+.52	+.24	39	+.12	+.52	+1.00	+.44	-.16	+.24	+.44	+1.00	+.12	.00
N. W. India	38	+.08	+.22	+.14	+.12	+.12	+.04	-.06	-.04	+.24	-.32	38	-.28	-.22	.00	-.42	-.30	+.30	+.10	-.32	-.22	-.14
Port Darwin	38	+.46	+.48	+.38	+.02	+.12	+.14	+.08	-.06	-.38	-.44	38	-.34	-.54	-.66	-.68	-.64	-.04	-.20	-.24	-.30	-.26
Mauritius	38	+.30	-.02	-.26	-.06	-.18	+.08	-.30	+.10	-.22	-.12	38	-.30	-.06	-.22	+.16	-.10	-.24	+.02	+.04	-.12	-.18
Samoa	20	+.08	+.38	+.20	.00	+.04	+.02	+.38	+.48	+.10	+.60	20	+.46	+.42	+.74	+.22	+.50	+.20	+.44	+.42	+.56	+.28
S. E. Australia	38	+.28	+.30	+.32	-.10	+.20	+.06	+.14	-.14	-.16	-.30	38	-.24	-.46	-.28	-.38	-.54	-.26	-.04	-.04	-.30	-.18
Cape	38	+.16	-.20	+.30	+.10	.00	-.38	-.04	-.20	-.06	-.06	38	-.28	-.16	-.08	+.04	-.42	-.10	+.02	-.14	-.22	+.06
S. America	38	+.12	+.10	+.06	-.04	+.18	-.06	+.18	+.14	+.24	+.34	38	.00	+.30	+.52	+.32	-.06	-.02	+.24	+.32	-.08	+.28
Temperature																						
Dutch Harbor	35		-.08	-.24	-.16			-.18	-.22	+.04		35		-.40	-.04	-.20		+.02	-.12	-.22	-.02	
Rain																						
Peninsula (J-S)	39	-.42				+.26				+.30		39			+.46				+.02			
Java (O-F)	36			-.32				-.06				36	-.14				+.40				+.30	

[1] Sign omitted in original.

CHARLESTON PRESSURE

	Years of data	December-February					March-May					Years of data	June-August					September-November				
		Two quarters before Charleston	One quarter before Charleston	Same quarter	One quarter after Charleston	Two quarters after Charleston	Two quarters before Charleston	One quarter before Charleston	Same quarter	One quarter after Charleston	Two quarters after Charleston		Two quarters before Charleston	One quarter before Charleston	Same quarter	One quarter after Charleston	Two quarters after Charleston	Two quarters before Charleston	One quarter before Charleston	Same quarter	One quarter after Charleston	Two quarters after Charleston
		J-A	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*		*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*	*J-A*	*S-N*	*D-F*	*M-M*
Iceland	46	−0.06	+0.16	−0.32	−0.16	−0.20	+0.10	−0.18	−0.36	+0.14	+0.02	46	−0.12	−0.24	−0.02	−0.10	+0.04	−0.10	+0.02	−0.20	+0.02	−0.12
Alaska	20	−.14	+.32	+.36	−.32	+.02	−.20	−.42	+.14	+.06	−.14	21	−.28	+.16	+.18	−.12	.00	−.32	−.40	+.32	−.24	+.20
C. Siberia	40	−.36	+.12	−.30	−.32	−.04	−.20	−.34	−.32	−.24	−.26	40	−.18	−.10	−.26	−.22	−.16	+.34	−.02	−.20	−.04	+.24
Vienna	43	−.20	−.14	+.24	+.02	+.30	−.02	+.16	+.16	+.08	+.12	43	+.02	.00	+.16	+.10	−.04	+.14	−.12	+.22	−.04	+.32
Azores	45	−.04	+.02	+.36	+.14	+.12	−.06	−.10	+.52	+.12	−.22	45	+.02	+.38	+.26	−.08	−.10	−.16	−.04	+.12	−.14	+.02
Charleston	47	−.10	.00	+1.00	+.22	+.18	+.20	+.22	+1.00	+.52	+.06	47	+.18	+.52	+1.00	.00	−.10	+.06	.00	+1.00	.00	+.20
San Francisco	47	−.08	+.30	+.20	+.18	+.24	+.24	+.44	+.36	+.42	+.06	47	+.40	+.24	+.48	−.06	−.04	+.16	+.04	+.54	+.34	+.48
Tokio	38	−.06	+.08	+.24	.00	−.08	−.04	+.36	+.10	−.28	+.04	38	+.36	+.10	−.08	−.34	.00	+.14	+.18	+.14	+.06	−.20
Cairo	44	.00	+.24	+.08	−.20	+.10	−.04	+.04	+.06	+.06	−.06	44	−.20	−.22	−.14	−.30	−.16	+.06	−.06	−.12	−.04	+.18
Honolulu	37	+.30	+.22	−.20	−.12	+.10	−.02	+.20	−.08	−.14	−.40	37	+.20	+.04	−.08	−.18	−.10	+.30	+.10	−.08	+.04	−.10
N. W. India	45	−.02	−.42	−.52	−.46	−.30	−.22	−.28	−.36	−.28	+.42	45	−.14	−.24	−.52	+.20	+.24	−.02	+.04	−.20	−.22	−.32
Port Darwin	38	−.30	−.50	−.52	−.28	−.22	+.04	−.02	−.02	+.34	+.34	38	+.04	−.12	+.12	+.10	+.24	+.06	−.02	.00	+.02	−.04
Mauritius	45	−.02	+.06	−.12	+.10	+.06	−.22	−.44	−.06	+.08	−.02	45	−.20	−.14	+.10	−.14	−.06	−.28	−.24	+.14	+.06	−.12
Samoa	20	+.20	+.20	+.28	+.06	.00	+.38	+.26	−.12	−.20	−.36	20	+.32	−.04	−.22	−.38	−.08	−.26	−.10	+.04	+.24	−.04
S. E. Australia	44	−.24	−.38	−.30	−.28	−.22	−.26	−.16	−.18	+.02	+.08	44	−.04	−.06	−.12	+.06	+.12	−.02	−.26	−.12	−.16	−.18
Cape	45	+.08	+.08	−.26	+.10	+.18	−.12	−.04	+.08	−.12	+.10	45	−.10	−.04	−.16	−.02	+.02	−.06	+.12	−.22	−.16	+.22
S. America	45	+.20	+.14	−.08	+.22	+.08	+.34	+.02	+.12	−.06	+.20	45	+.06	+.10	+.04	+.04	+.44	+.20	+.04	+.22	−.04	+.26
Temperature																						
Dutch Harbor	36	------	−.14	−.08	−.18	------	------	−.34	+.24	+.18	+.26	36	------	−.12	−.20	−.10	------	------	−.04	+.10	−.18	------
Rain																						
Peninsula (J-S)	45	+.20	------	------	------	−.10	------	------	------	−.08	------	45	------	------	.00	------	------	------	+.12	------	------	------
Java (O-F)	40	------	------	+.20	------	------	------	.00	------	------	------	40	−.10	------	------	------	+.06	------	------	------	+.06	------

HONOLULU PRESSURE

In the north Pacific oscillation [9] Honolulu is very prominent in the first half year, its coefficient with Alaska based on 19 years being −0.70 in winter and −0.52 in spring. In the North Atlantic oscillation its activity is mainly confined to the summer and is relatively weak (−0.34 with Iceland and +0.20 with the Azores). In the southern oscillation it exercises in summer a very strong control as a member of the first group, having coefficients of −0.66, −0.68, −0.64 with pressure at Port Darwin in that season and the two following; and, in addition to high contemporary coefficients with Samoa, South America, and Peninsula rain, it has coefficients with conditions two quarters later (i. e., in the southern summer) of +0.50 at Samoa, −0.54 in southeast Australia, −0.42 at the Cape and +0.40 with Java rain. In autumn its influence is less, though it still gives information regarding some of the conditions in the southern summer. But in winter Honolulu behaves as a not very decided member of the second group of the southern oscillation and has coefficients of +0.38, +0.32, +0.30, and −0.32 with pressure at Port Darwin, southeast Australia and the Cape, and with Java rain; its associations with conditions two quarters before, +0.46 with Port Darwin and −0.42 with Peninsula rain, are also of this reversed type.

In spring the adherence to the first group is already setting in and there is a forecast of conditions two quarters later of −0.44 with Port Darwin and +0.60 with Samoa, together with smaller coefficients in northwest India, southeast Australia, and South America.

[9] Doctor Walker considers three great pressure oscillations as follows: (1) The North Atlantic, which consists of an accentuation of the pressure differences between the Azores and Iceland in autumn and winter, and an associated strong circulation of the winds in the Atlantic, a strong Gulf Stream, high temperatures in winter and spring in Scandinavia and the east coast of the United States, and with lower temperatures on the east coast of Canada and the west of Greenland. (2) The North Pacific oscillation: This oscillation at first sight seems to resemble that of the North Atlantic, but the meteorological observations are either wholly lacking or fragmentary, and it is therefore impossible to trace the resemblance further than that of a very general nature. (3) The southern oscillation: By the southern oscillation is implied the tendency of pressure at stations in the Pacific (San Francisco, Tokio, Honolulu, Samoa, and South America) and of rainfall in India and Java * * * to increase while pressure in the region of the Indian Ocean (Cairo, northwest India, Port Darwin, Mauritius, southeast Australia, and the Cape) decreases.—*Ed.*

CHARLESTON PRESSURE

In winter there are, apart from Alaska, four coefficients exceeding the probable value of the greatest random coefficient, and two up to 0.30; the coefficient with Alaska is of doubtful significance. Thus the position of Charleston in the North Atlantic oscillation is established and it is our first northern station to show a definite association with the positive group of the southern oscillation, the coefficients of −0.52 with northwest India and Port Darwin only occurring once in 9,000 times by accident. It is also characteristic of relations with more distant parts of the world that, as we should expect, they persist over longer periods than relations between adjacent areas, and the coefficients of Charleston winter pressure with pressure in northwest India, Port Darwin, and southeast Australia a quarter before and a quarter after are nearly as prominent as they are for the contemporary quarter. With conditions two quarters before and after the coefficients are of less significance and are in general indicative of the same relationships.

In spring Charleston continues typical of the high pressure belt in the North Atlantic oscillation (see its relations with Iceland and the Azores), and its opposition to central Siberia persists. With the season one before or behind there are five significant coefficients, and those for the previous quarter indicate that a strengthening in winter of the North Pacific oscillation (Alaska, San Francisco, Dutch Harbor) or of the southern oscillation (northwest India, Mauritius) will cause a rise of pressure at Charleston in spring. In the succeeding quarter the relations are more local. Two seasons before there is some association of high pressure with a strengthening of the southern oscillation, but two seasons later it is with a weakening (i. e., −0.40 with Honolulu −0.36, Samoa, +0.42 northwest India, and +0.34 Port Darwin).

In summer the North Atlantic relations are weaker, but similarity with San Francisco and dissimilarity with northwest India are marked.

In autumn Charleston is more isolated; its only strongly marked relations are with San Francisco in the same quarter and the two subsequent.

UPPER-AIR OBSERVATIONS AT APIA OBSERVATORY

By ANDREW THOMSON

[Apia Observatory, Apia, Western Samoa]

This preliminary report summarizes the results of 141 pilot-balloon flights taken at Apia Observatory between June 1, 1923, and December 31, 1924. The complete data giving the details for individuals flights will be published shortly in an observatory bulletin.

The Apia Observatory, 13° 48.4′ S, 171° 46′ 30″ W, on the island of Upolu of the Samoan group, is situated in the western portion of the South Pacific Ocean. It lies very remote from large land masses, the coast of South America is 10,000 kilometers to the east and the continent of Australia 4,000 kilometers to the west. Although there are numerous islands in this expanse, their area is so small that the effects exerted on the great circulation of the atmosphere must be inconsiderable.

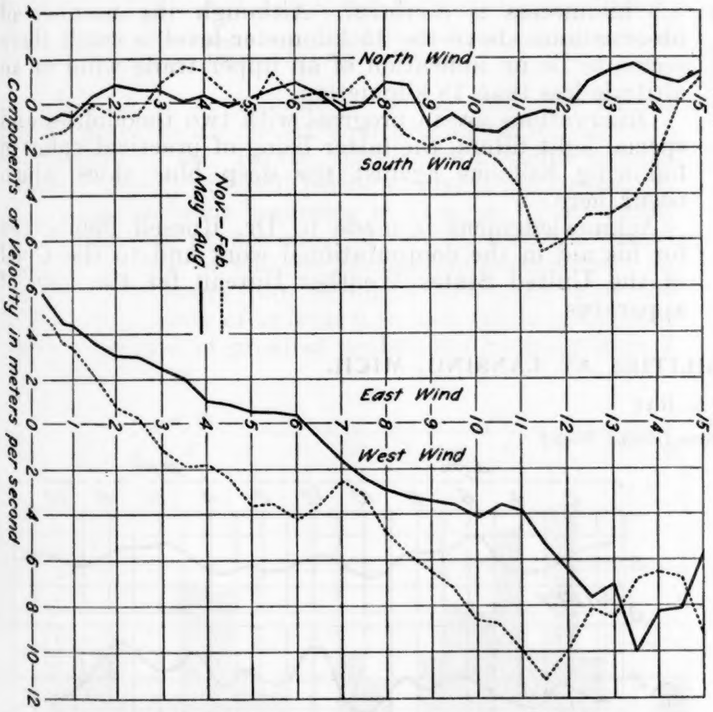


FIG. 1.—Components of winds in the upper air at Apia, Western Samoa (13° 48.4′ S., 171° 46.5′ W.)

On the open ocean in the vicinity of Samoa trade winds from the quadrant southeast to northeast blow for 48 per cent of the time during the quarter December to February and for 85 per cent of the time from June to August.[10] The observatory is shielded from south winds by a range of hills which reach a height of 1,100 meters, the effect of which in diverting the circulation to a more east-west direction has been found by kite observations to extend to an altitude of 500 meters.[11]

Rubber balloons weighing 25–35 grams and 60–70 grams were inflated to rise at a rate of 180 meters per minute. The single theodolite method was employed and the procedure and methods of the United States Weather Bureau were adopted throughout. Balloons were sent up on almost every occasion when the sky gave promise of remaining free from clouds for 30 minutes or more; about 80 per cent of the ascents were made between 10 a. m. and 3 p. m. One balloon was observed to a

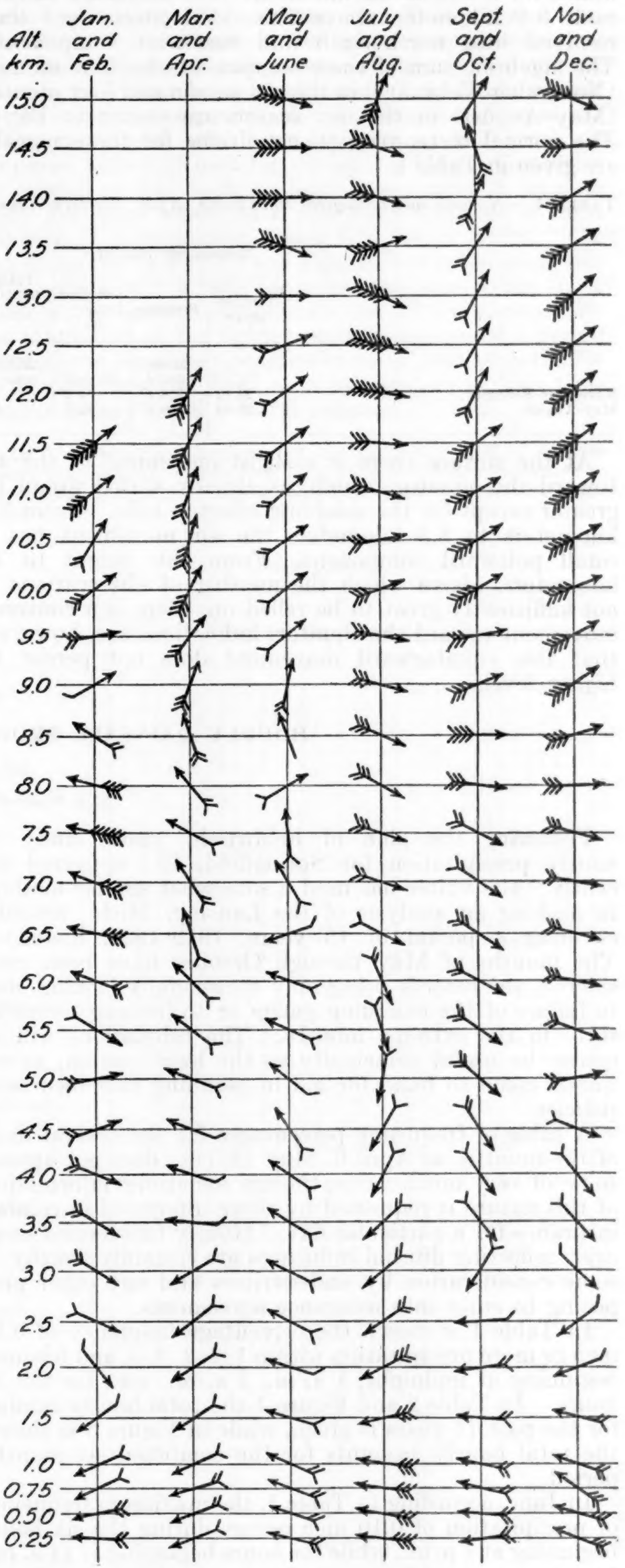


FIG. 2.—Mean wind directions and velocities at Apia, Western Samoa. Arrows fly with the wind: Velocities in meters per second, each feather representing one meter per second.

[10] South Pacific Pilot Charts, U. S. Hydrographic office.

[11] G. Angenheister, a summary of the meteorological observations of the Apia Observatory, p. 51.

height of 21 kilometers, 5 to 15 kilometers, 40 to 10 kilometers, and 76 to 5 kilometers.

The velocity and direction of each flight was determined for levels of 0.25 kilometer to 1 kilometer and for each 0.5 kilometer above this. Velocities were then resolved into north-south and east-west components. The algebraic sum of these components for four months (November–February) in the wet season and four months (May–August) in the dry season are shown in Fig. 1 The normal meteorological conditions for these months are given in Table 1.

TABLE 1.—*Normal meteorological conditions, Apia, Western Samoa*

	Mean hourly value of—			Total rainfall
	Temperature	Pressure	Relative humidity	
	° C.	*Millimeters*	*Per cent*	*Millimeters*
November–February	26.12	756.47	84.2	352
May–August	25.44	758.87	82.2	104

At the surface there is a slight movement of the air toward the equator, which, as already stated, would be greater except for the shielding effect of hills. From 2.5 kilometers to 8.5 kilometers the air movement has a small poleward component. From this height to 12 kilometers, above which the number of observations is not sufficiently great to be relied on, there is a contrary movement toward the equator; indications are, however, that this equatorward movement does not persist to higher levels.

The low values of the north-south components are not due to large south values being canceled by large north values; the components themselves were consistently low. This was apparent while making the observations, the balloons being taken far out to the westward and then after passing through a very thin layer of nonmoving air were brought back approximately over the heads of the observers.

The east-west components are much simpler; the trade wind movement to the west decreases steadily with altitude, becoming zero at 2.5 kilometers in November–February, and 6.2 kilometers in May–August. The antitrades setting in at these levels continues to increase in velocity to a height of 12 kilometers.

The resultant wind was obtained by combining the components. The data for each period of two months are shown graphically in Figure 2. Owing to the prevailing cloudy weather during January and February, there are few balloon flights, and the intrusion of a westerly wind between the levels 2.0 kilometers and 5.5 kilometers is doubtful. Although the number of observations above the 15 kilometer level is small there seems to be no indication of an upper trade wind at an altitude less than 18 kilometers.

Observations are in progress with two theodolites and special light filters, the latter being of practical value in following balloons against the deep blue skies which occur here.

Acknowledgment is made to Dr. Russell Pemberton for his aid in the computational work and to the Chief of the United States Weather Bureau for the loan of apparatus.

HOURLY RAINFALL PROBABILITIES AT LANSING, MICH.

By C. L. RAY

[U. S. Weather Bureau, Lansing, Mich.]

Following the plan of Feldwisch, whose study of hourly precipitation for Springfield, Ill., appeared recently,[12] the writer has used a somewhat similar method in making an analysis of the Lansing, Mich., records, covering a period of 15 years, 1910–1924, inclusive. The months of May through October have been considered, the records being only occasionally lacking, due to failure of the recording gauge or to freezing temperatures in the extreme months. The tabulations will of course be useful principally to the local station, as requests come to hand for aid in planning rain insurance policies.

A table of frequency percentages for the several days of the months, as April 6, May 12, etc., does not appear to be of very much value, though sometimes information of this nature is requested by those interested in rainfall insurance for a particular day. Hourly frequencies however, reflecting diurnal influences are certainly worthy of some consideration by underwriters and any other proposing to enter into insurance agreements.

In Table 1 is shown the percentage frequency of 0.10 inch or more precipitation within 1, 2, 3, 4, 5, and 6 hours, beginning at midnight, 1 a. m., 2 a. m., etc., for the 24 hours. In Table 2 and Figure 1 the total hourly rainfall for the past 15 years is given, while in Figure 3 is shown the total hourly amounts for the combined six months period.

In June, according to Table 1, the maximum frequency of precipitation of 0.10 inch occurs during the six hours beginning at 4 p. m., while the hours beginning at 11 a. m., 12 noon, etc., until 4 p. m., 5 p. m., and 6 p. m., are all

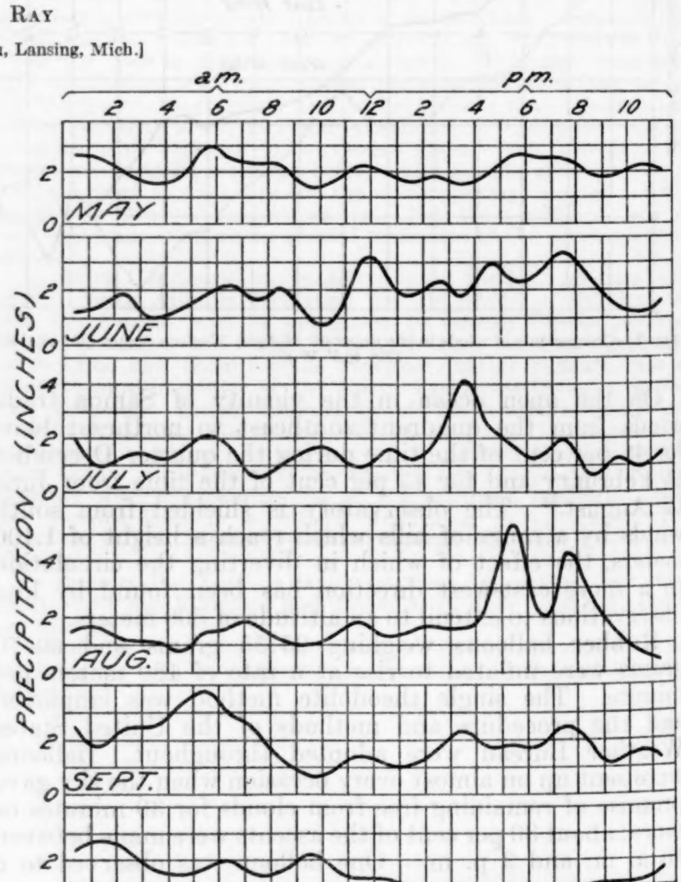


FIG. 1.—Total hourly amounts of precipitation, May to October, 1910-1924, inclusive, Lansing, Mich. Data from Table 2

[12] MO. WEATHER REV. 42: Dec., 1924, 581.

more favorable than any other hours as the initial hour of a six-hour period within which 0.10 inch of precipitation is most probable. In July the six-hour period beginning at 12 noon is most favorable for the 0.1-inch fall, though only slightly less so are the periods beginning at 11 a. m., 1, 2, and 3 p. m. In August the most favorable hours in this same connection are those

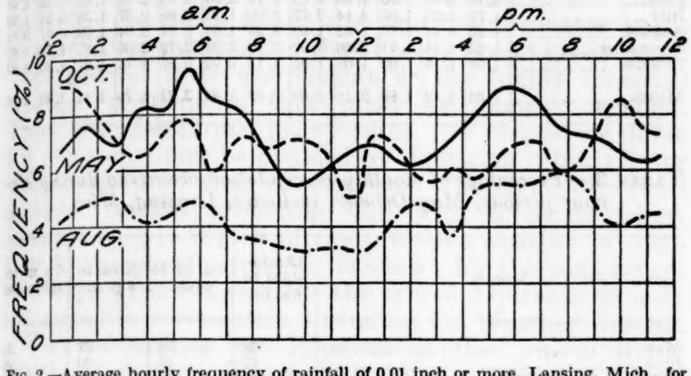


FIG. 2.—Average hourly frequency of rainfall of 0.01 inch or more, Lansing, Mich., for the years 1910-1924, inclusive

beginning at 2 p. m., and 3 p. m., although almost equally favorable are the six-hour periods beginning at 12 noon and 1 p. m. In the spring and autumn months there is a slightly different period of maximum frequency. In May the six hours beginning at 11 p. m., 12 midnight, 1, 2, 3, and 4 a. m. are most favorable, with the period beginning at 2 a. m. showing the highest percentage. In September the hours from midnight to 6 a. m. show the greatest probability of at least 0.10 inch, while in October there is a period of greatest probability running from 7 p. m. until 1 a. m.

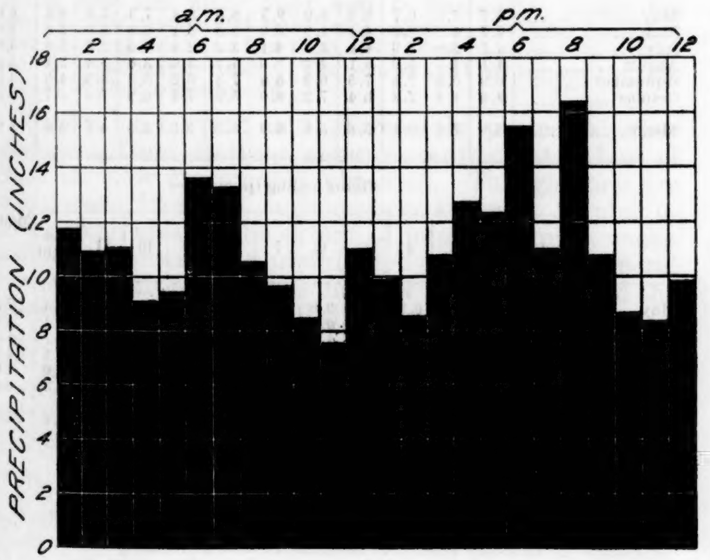


FIG. 3.—Total rainfall in inches for each hour of the day for months of May to October, 1910-1924, inclusive, at Lansing, Mich.

In Table 3 are shown the percentages of actual rainfall for the six hour periods, midnight to 6 a. m., 6 a. m. to 12 noon, etc. By these figures it is seen that during the summer months the hours from noon to 6 p. m. are most favorable for precipitation, while in May, September, and October there is a slight margin in favor of the hours between midnight and 6 a. m. Thus is shown a rather marked agreement of the results from Tables 1 and 3.

In Table 4 and Figure 2 the lighter precipitation has been included in a calculation of hourly frequency. These lighter rains bring the frequency to a figure from four to seven times greater than the heavier showers the minimum rate of which was placed at 0.10 inch as compared with 0.01 inch for the lighter type. Generally the rainfall of 0.01 inch an hour is too light in total to verify insurance where as a rule there must be at least 0.10 inch of precipitation within four to six hours. The data contained in Table 4 and Figure 2 are interesting, but not as satisfactory a basis for insurance plans as are those tables where heavier showers are considered exclusively. The tabulation of the lighter rainfall does show a period of maximum frequency practically coincident with that of the heavier type, so that as a verification of this time element it may serve a useful purpose.

TABLE 1.—*Percentage frequency of the occurrence of 0.10 inch or more precipitation within 1, 2, 3, 4, 5, and 6 hours beginning at midnight, etc., for 24 hours at Lansing, Mich. (years 1910-1924, inclusive)*

Month	Length of period (hours)	Period beginning (a. m.) at—											
		Midnight	1	2	3	4	5	6	7	8	9	10	11
May	1	2.4	2.3	1.3	0.9	1.2	1.4	0.7	1.7	1.2	0.7	0.9	1.4
	2	3.9	3.7	2.7	2.4	1.6	3.2	3.2	3.0	2.2	1.1	1.2	2.2
	3	4.5	3.9	3.7	3.2	3.9	4.5	3.9	4.1	2.9	2.0	2.0	3.3
	4	5.7	5.5	5.5	5.7	5.5	5.7	5.7	4.8	3.9	3.3	3.7	5.0
	5	6.5	6.1	7.2	6.7	7.0	7.2	6.5	5.8	5.2	5.5	5.2	6.1
	6	7.6	7.6	8.2	7.7	7.5	7.4	7.2	6.3	6.1	6.3	5.9	7.0
June	1	.7	.7	1.4	.7	1.0	1.2	1.4	1.2	1.0	.7	.5	1.6
	2	1.7	2.4	2.4	2.1	2.9	3.6	3.4	2.9	1.8	1.1	1.6	2.3
	3	3.1	2.6	3.1	3.3	3.6	4.0	3.6	3.4	2.4	2.7	2.9	3.1
	4	3.8	3.6	3.6	3.8	4.3	4.6	4.6	4.1	4.2	3.6	3.6	4.5
	5	4.5	5.0	5.0	5.0	5.3	5.3	5.5	6.0	5.0	4.8	5.5	5.4
	6	5.0	5.6	5.3	6.0	5.6	6.0	6.5	6.0	5.2	6.0	5.6	7.4
July	1	1.1	.2	.5	1.6	.9	1.2	1.4	.5	.7	.9	.7	.7
	2	1.4	.5	1.6	1.9	1.9	2.5	1.6	.9	1.6	1.4	1.6	1.9
	3	2.1	1.8	2.3	3.0	3.3	3.0	2.3	1.6	1.8	2.5	2.1	3.0
	4	3.3	2.6	3.3	3.5	3.5	3.5	2.5	1.6	2.5	3.0	3.5	3.7
	5	4.1	3.5	3.9	4.2	3.9	3.9	2.8	2.8	3.5	4.4	4.9	6.0
	6	4.6	4.2	4.2	4.6	4.2	4.1	3.5	3.7	4.9	5.3	6.9	6.9
August	1	1.2	1.5	.9	.5	.7	.9	.9	1.2	.7	.7	.9	1.4
	2	2.5	2.1	1.4	1.2	1.9	1.9	1.2	1.6	1.2	1.6	2.1	1.8
	3	3.5	2.6	1.4	2.1	2.5	2.3	1.6	2.5	2.5	2.8	3.2	2.6
	4	3.7	3.0	2.8	2.6	2.8	2.6	2.6	3.5	3.2	3.7	3.7	3.7
	5	3.9	3.5	3.3	2.8	3.3	3.0	3.0	3.9	4.1	3.9	4.4	5.1
	6	4.9	4.9	3.9	3.3	4.2	3.9	3.7	5.1	4.6	5.1	5.8	6.7
September	1	1.9	1.2	1.2	2.1	1.9	2.8	2.3	1.9	1.0	.5	.5	1.4
	2	2.7	2.1	2.3	3.1	4.1	3.6	3.3	2.3	2.1	1.2	1.4	2.3
	3	4.1	3.6	4.6	5.3	5.0	4.5	4.0	3.3	3.1	2.1	2.3	3.6
	4	4.7	5.2	6.5	5.8	5.5	4.8	4.8	4.3	4.0	3.6	3.6	4.3
	5	6.5	6.9	6.9	6.6	5.6	5.5	5.0	5.2	5.0	5.0	4.7	5.6
	6	8.7	7.6	7.8	6.9	6.7	6.0	5.5	6.0	5.8	5.5	5.6	6.0
October	1	1.3	2.1	1.6	1.1	.9	.9	1.1	.7	1.1	1.4	.7	.9
	2	3.9	3.3	1.7	2.0	2.1	1.7	2.3	2.3	2.8	2.2	1.4	1.8
	3	4.5	3.8	2.6	2.8	3.5	2.8	3.5	3.8	3.5	2.6	2.5	3.2
	4	4.8	5.2	3.5	4.2	4.4	3.8	4.5	4.4	3.8	3.3	3.5	4.2
	5	5.8	5.5	4.8	4.8	4.8	5.0	5.6	4.8	4.3	4.8	5.2	4.8
	6	6.5	6.3	5.2	5.2	6.0	5.9	6.3	5.6	5.6	6.0	6.0	5.2
Means	1	1.4	1.3	1.2	1.2	1.1	1.4	1.3	1.2	1.0	.8	.7	1.2
	2	2.7	2.4	2.0	2.1	2.4	2.8	2.5	2.2	2.0	1.4	1.6	2.0
	3	3.6	3.0	3.0	3.3	3.6	3.5	3.2	3.1	2.7	2.4	2.5	3.1
	4	4.3	4.2	4.2	4.3	4.3	4.2	4.1	3.8	3.6	3.4	3.6	4.2
	5	5.2	5.1	5.2	5.0	4.6	5.0	4.7	4.8	4.5	4.7	5.0	5.5
	6	6.2	6.0	5.8	5.6	5.7	5.6	5.4	5.4	5.4	5.7	6.0	6.5

TABLE 1.—*Percentage frequency of the occurrence of 0.10 inch or more precipitation within 1, 2, 3, 4, 5, and 6 hours beginning at midnight, etc., for 24 hours at Lansing, Mich. (years 1910–1924, inclusive)*—Continued

Month	Length of period (hours)	Period beginning (p. m.) at— 12	1	2	3	4	5	6	7	8	9	10	11	Mean
May	1	0.9	0.9	1.5	0.7	1.2	1.4	1.4	1.8	1.8	0.5	0.9	1.3	1.2
	2	2.0	1.7	2.0	2.0	3.0	2.5	3.2	3.0	2.8	2.8	2.6	2.8	2.5
	3	2.4	2.3	3.2	2.8	4.1	4.0	3.9	3.2	3.4	3.2	3.4	4.1	3.4
	4	2.8	4.3	4.5	4.1	6.0	5.8	5.2	5.0	5.0	4.8	5.6	6.0	5.0
	5	5.8	6.1	5.8	5.8	6.4	6.1	5.8	6.1	5.8	5.8	6.3	6.7	6.2
	6	6.3	6.3	6.9	6.3	6.6	6.4	6.9	6.7	6.4	6.4	6.7	7.6	6.6
June	1	1.3	.9	1.6	.7	2.6	2.4	1.2	2.1	2.1	1.7	.7	1.4	1.2
	2	2.5	2.3	2.3	3.1	3.6	3.1	2.9	3.3	4.0	2.9	1.9	1.9	2.6
	3	3.6	3.4	4.5	4.9	4.9	4.7	4.3	5.0	5.0	3.8	2.6	2.9	3.6
	4	4.3	5.4	5.8	5.6	5.8	5.2	5.7	6.4	6.4	4.5	3.6	3.8	4.7
	5	6.6	6.6	6.8	6.7	6.7	6.9	6.7	6.7	6.6	5.5	4.3	5.0	5.7
	6	7.1	7.4	7.6	7.6	8.2	7.8	7.9	7.2	6.9	6.4	5.0	5.5	6.4
July	1	1.4	1.2	1.2	2.1	1.8	1.2	.9	.9	.2	.9	.5	1.6	1.0
	2	1.9	2.5	4.1	4.1	3.5	3.0	1.8	1.4	1.3	1.3	1.6	2.3	2.0
	3	3.6	5.1	5.1	5.3	4.4	3.0	2.1	2.1	1.9	2.3	2.6	2.6	3.0
	4	5.8	5.7	6.2	6.5	4.8	3.7	3.0	2.6	2.8	3.3	3.3	3.0	3.6
	5	6.7	7.1	6.9	6.5	5.1	4.2	3.0	3.3	3.7	3.3	3.5	4.2	4.4
	6	8.1	7.6	7.1	6.7	5.6	4.6	3.9	3.9	3.7	3.7	4.2	4.5	5.0
August	1	1.2	.7	1.2	1.2	1.8	1.7	1.6	2.1	1.6	.5	.5	.9	1.1
	2	1.9	2.1	2.5	2.8	3.3	2.8	3.2	3.2	1.6	.7	1.2	1.4	2.0
	3	3.0	3.4	4.4	4.3	3.9	4.1	3.9	3.3	1.6	1.0	2.1	3.0	2.8
	4	4.6	5.3	5.3	4.9	5.1	5.3	4.4	3.3	2.1	2.3	3.7	3.7	3.7
	5	6.5	6.7	6.7	6.9	6.5	5.8	4.9	3.9	3.5	3.9	4.5	3.7	5.0
	6	7.6	7.4	8.1	8.1	6.9	5.8	5.3	4.9	4.9	4.6	4.8	4.1	5.4
September	1	1.4	1.9	1.0	2.6	1.7	1.0	1.1	1.6	1.2	1.1	.5	.5	1.4
	2	2.6	2.9	3.1	2.9	2.4	2.4	2.7	2.4	2.4	1.8	2.0	2.4	2.5
	3	3.4	3.4	4.3	3.8	4.1	3.5	3.5	3.4	2.4	3.1	3.6	4.1	3.7
	4	4.8	5.0	4.8	5.5	5.3	5.2	4.2	3.4	3.6	4.3	5.0	5.0	4.7
	5	4.9	5.2	4.9	5.8	5.4	5.4	4.4	4.0	4.7	5.2	5.0	5.0	5.4
	6	6.3	6.3	6.5	7.0	6.4	6.1	5.2	5.4	6.0	6.2	5.6	5.4	6.2
October	1	.9	.7	.5	.3	.5	.2	.5	.0	.9	.7	.7	1.4	.9
	2	1.4	1.5	1.1	1.0	1.2	.9	.7	1.6	1.8	1.8	2.5	4.0	2.0
	3	3.0	2.3	1.9	1.9	1.9	1.4	2.3	4.0	3.0	3.5	4.3	5.5	3.1
	4	3.8	3.0	2.1	2.3	2.3	2.6	3.5	4.4	4.4	5.3	5.6	5.8	3.9
	5	4.8	3.9	3.5	3.0	3.5	3.8	4.6	6.0	5.8	6.0	6.0	6.0	4.9
	6	5.0	4.3	4.1	4.1	4.8	5.0	6.0	6.7	6.3	6.3	6.3	6.3	5.4
Means	1	1.2	1.0	1.2	1.3	1.6	1.3	1.1	1.4	1.3	.9	.6	1.2	1.1
	2	2.0	2.2	2.5	2.6	2.8	2.4	2.4	2.5	2.3	1.9	2.0	2.1	2.2
	3	3.2	2.3	3.9	3.6	3.9	3.4	3.3	3.5	2.9	2.8	3.1	3.7	3.2
	4	4.4	4.8	4.8	4.8	4.9	4.6	4.3	4.2	4.0	4.1	4.6	4.6	4.3
	5	5.9	5.9	5.8	5.8	5.6	5.4	4.9	4.8	5.0	5.0	4.9	5.1	5.1
	6	6.7	6.6	6.7	6.6	6.4	6.0	5.7	5.8	5.7	5.6	5.4	5.6	5.9

TABLE 2.—*Total hourly amounts of precipitation (inches) May–October, for 15 years, 1910–1924, inclusive, Lansing, Mich.*

	Hours ending (a. m.) at— 1	2	3	4	5	6	7	8	9	10	11	12
May	2.86	2.83	2.18	1.89	1.74	2.99	2.56	2.48	2.40	1.41	1.60	2.25
June	1.04	1.31	1.95	0.94	1.19	1.75	2.40	1.72	2.08	1.17	0.85	3.24
July	1.94	0.87	1.24	1.10	1.41	2.11	1.96	0.52	1.33	1.53	1.61	0.88
August	1.39	1.58	1.00	1.14	0.92	1.29	1.38	1.70	0.97	0.89	1.09	1.87
September	2.41	1.70	2.41	2.32	2.67	3.93	3.01	2.67	1.34	[illegible]	0.72	1.47
October	2.30	2.70	2.24	1.68	1.49	1.55	2.02	1.44	1.49	2.51	1.73	1.33
Means	1.99	1.83	1.84	1.51	1.57	2.27	2.22	1.76	1.60	1.41	1.27	1.84

TABLE 2.—*Total hourly amounts of precipitation (inches) May–October, for 15 years, 1910–1924, inclusive, Lansing, Mich.*—Con.

	Hours ending (p. m.) at— 1	2	3	4	5	6	7	8	9	10	11	12
May	2.02	1.60	1.94	1.44	1.84	2.86	2.53	2.59	1.96	1.99	2.38	2.11
June	2.16	1.90	2.50	1.86	3.03	2.44	2.56	3.53	2.35	1.68	1.12	1.64
July	1.73	1.23	1.93	4.14	2.77	2.00	1.22	2.08	0.57	1.38	0.94	1.90
August	1.25	1.43	1.70	1.62	1.92	5.39	1.84	4.54	2.64	1.08	0.91	0.64
September	1.23	1.14	1.71	2.66	1.92	1.90	1.91	2.79	2.06	1.17	1.78	1.65
October	1.48	1.19	1.00	1.05	1.04	1.12	0.92	0.87	1.14	1.37	1.30	1.83
Means	1.64	1.42	1.80	2.13	2.09	2.62	1.83	2.73	1.79	1.44	1.40	1.63

TABLE 3.—*Percentage of monthly precipitation occurring during six-hour periods, May–October, inclusive, Lansing, Mich.*

Month	12 midnight to 6 a. m.	6 a. m. to noon	Noon to 6 p. m.	6 p. m. to midnight
May	28	24	22	26
June	17	25	30	28
July	23	20	36	21
August	18	20	33	29
September	32	22	22	24
October	32	29	19	20
Means	25	23	27	25

TABLE 4.—*Percentage of times 0.01 inch or more of rain has fallen during each hour for the months May–October, years 1910–1924, inclusive, Lansing, Mich.*

	Hours ending (a. m.) at— 1	2	3	4	5	6	7	8	9	10	11	Noon
May	6.7	7.5	6.7	8.2	8.0	9.7	8.6	8.4	7.3	5.6	6.0	6.4
June	4.7	4.2	6.0	4.4	4.9	6.0	5.3	5.1	6.0	5.6	5.6	4.6
July	4.1	2.8	3.9	4.4	3.0	4.1	3.2	2.4	3.9	2.6	3.4	4.5
August	4.1	4.7	5.2	4.1	4.1	5.0	4.7	3.6	3.6	3.4	3.4	3.6
September	6.9	5.8	7.3	7.5	6.2	8.6	7.3	6.0	5.3	4.9	4.9	4.4
October	9.0	8.8	7.3	6.4	7.3	8.0	5.8	7.3	6.9	7.3	6.7	5.2
Means	5.9	5.6	6.1	5.8	5.6	6.9	5.8	5.5	5.5	4.9	5.0	4.8

	Hours ending (p. m.) at— 1	2	3	4	5	6	7	8	9	10	11	Midnight	Mean
May	6.9	6.0	6.2	6.9	7.5	9.0	8.8	7.5	7.3	7.1	6.2	6.4	7.3
June	3.4	5.8	5.6	5.3	6.2	6.9	6.0	5.8	4.7	5.6	4.2	5.1	5.3
July	5.0	5.4	5.4	5.2	4.7	4.7	3.9	3.2	4.1	3.9	4.1	4.1	4.0
August	3.6	4.5	4.7	3.6	5.4	5.4	5.4	6.0	5.4	4.1	4.4	4.5	4.4
September	4.2	4.2	5.6	5.3	5.6	5.6	6.9	5.1	6.2	5.8	5.1	6.0	5.9
October	6.9	6.7	5.6	6.0	5.6	6.7	6.9	5.8	6.4	8.4	7.5	7.3	6.9
Means	5.0	5.4	5.5	5.4	5.8	6.4	6.3	5.6	5.7	5.8	5.2	5.6	5.6

THE PRESENT METEOROLOGICAL NEEDS OF AERONAUTICS

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[Read before the American Meteorological Society, Washington, D. C., May 1, 1925. Abstracted by B. M. Varney.]

Pointing out that present-day aircraft are in surprising measure independent of weather conditions, the paper indicates the items relative to which the aviator needs more detailed information than he now has at his disposal.

In general it is the violent or the highly localized weather phenomena that must be guarded against. Thus, thunderstorms, heavy rains, low clouds, or dense fog can sometimes be avoided by detouring if the aviator is forewarned of their occurrence. The trend of official activity toward providing him with forecasts which attempt to give *details* of the probable weather in addition to the general forecast is shown by the conferences now in progress between the Government bureaus directly interested in aeronautics, including the Weather Bureau.

Two difficulties are inherent in the *general* flying weather forecast. The time of issue, necessarily placed at about 10 a. m. and 10 p. m., seventy-fifth meridian, is obviously unsuitable for the purposes of the aviator about to make an early morning start on a long flight; and the need for brevity in the general forecasts deprives the aviator of, to him, important details as to kind, time, locality, intensity and duration of the local weather phenomena he is likely to encounter. The following quotation from Lieutenant Reichelderfer's paper well illustrates the sort of difficulty that may arise:

> The general forecast of "overcast sky" may on one occasion cover the condition when clouds are several thousand feet high and of no practical importance to the aviator, while on another occasion, the overcast sky may consist of low clouds which obscure the landing field and make flight next to impossible. Again the forecast "low clouds and rain" may describe anything from low stratus several thousand feet thick with heavy rain, to thin stratus and an occasional sprinkle. The one is next to impassible; the other is of little consequence.

Reports of current and of recently passed weather conditions from stations along a contemplated line of flight are now customarily obtained. Though they are in no sense forecasts, such reports are very helpful in giving some idea of the extent of important phenomena and hence constitute a useful supplement to the general forecast. This is clearly an intermediate step toward the ultimate provision of detailed flying weather forecasts.

> Good visibility is one of the most important meteorological conditions to the aviator. If he can see, he does not care so much about rain, snow, clouds, or high winds. * * * Unfortunately, visibility is one of the very difficult things to forecast. Poor visibility, as the aviator sees it, may be caused by fog, by haze or smoke, or by low clouds. Any of these interfere with landing maneuvers and increase the difficulties of navigation. * * * Probably an increased demand for visibility forecasts will stimulate investigation into this subject and better means of forecasting it will be developed. In the meantime frequent reports of visibility are the best means the aviator has of determining how far he can see. * * *
>
> The psychological effect on the aviator and passengers of a foreknowledge of weather conditions is in itself sufficient reason for a regular weather service for scheduled flights. When the plane runs into thickening weather, the pilot will know whether he can soon run out of it, or whether it will continue to grow worse. He will know whether to seek a safe landing place or to continue, assured of running into better weather. This psychological advantage has a large economical value. An incident which occurred a few months ago serves as an example. Two planes started out from Washington to fly to New Jersey. They were not flying in company. One flew at comparatively low altitude to avoid head winds which were reported at higher levels. As he approached Baltimore the weather grew thicker, the visibility becoming alarmingly poor. It appeared still more threatening ahead, and from the plane, which was flying at about 2,500 feet, the conditions seemed to be growing momentarily worse in every direction. The aviator climbed a few hundred feet in an effort to get above the thick weather. He saw no improvement and observations of the air above him indicated that the conditions extended to several thousand feet altitude. By this time visibility was so low that flying became difficult. In flying parlance it was thick as "pea soup." Concluding that a storm was forming, the pilot turned back for Washington. The other plane, which was faster and had climbed to 5,000 feet reached its destination in New Jersey without difficulty. It reported, however, that it encountered an unusually dense haze between Baltimore and Philadelphia, extending up to 5,000 feet altitude, which completely obscured the ground. A dense haze, apparently a combination of smoke with true meteorological haze, is characteristic of some localities under certain conditions. It is also characteristic that the haze is sometimes very difficult for an aviator flying into it gradually to distinguish from the gradual thickening and clouding over which comes in the formation of some heavy thunderstorms. Such meteorological formations have an appearance when viewed from an airplane at high altitudes very different from that at the surface and are rather difficult to identify.

The meteorological problems of the lighter-than-air ship, while in many respects similar to those of the heavier-than-air, are in certain respects different. The lighter-than-air ship does not have to keep moving to remain aloft. Hence the effects of fog or poor visibility can be countered by hovering. Gales, as affecting the overground speed of the ship, are at present perhaps the item of greatest importance, as either a help or a hindrance to progress. Hence the need for a knowledge of the extent, duration, and other characteristic details which can not practically be included in the general gale warnings has resulted in the assignment to the technical staffs of airship units of a meteorologist—

> who has given special study and had experience in furnishing the kind of weather information which the airship requires. In doing this the meteorologist usually combines with his knowledge of the weather map the ability to interpret local observations. To prepare a weather map he must, of course, call upon the Weather Bureau for complete synoptic reports. Until such time as airship ports are plentiful and airships have a selection of places in which to refuel when head winds deplete their fuel supply it is probable that bases will require synoptic weather reports as they do at present in order that the airship meteorologist can draw his complete weather map and prepare the detailed inferences required. Perhaps even when airships become common it will be found most economical to have a meteorological observatory at each large base and an airship meteorologist to give the detailed information which is essential to most efficient operation and which can not be completely anticipated in a published forecast.

Selection of favorable flying levels in relation to speed and direction of air movement will become increasingly important, and methods must be devised for extending our aerological observations to include the getting of information from above a cloud cover—a matter quite as important to the meteorologist as to the aviator.

> It appears that the large amount of meteorological detail desired by aviation will gradually result in an increase in the amount of local data included in weather reports, an increase in the frequency of reports, and possibly the preparation of more detailed flying forecasts by local meteorologists. It seems certain as the demands become more insistent and the benefits are shown to be worth the increased cost that funds for the purpose will be appropriated.

THE RAINFALL CAPACITY OF THE "EQUATORIAL CURRENT," A PERIODIC FACTOR IN CLIMATE

By LOUIS BESSON

[Translation by B. M. Varney]

In studying the observations made during a half century at the Observatory of Montsouris one is brought to a result of which the significance extends probably far outside the immediate environs of Paris.

The examination of the amounts of rainfall has already shown [13] that a change occurred about 1900 in the raininess of the seven months November to May, a period which has become, on the average, since then rainier than before, the difference amounting to 27 per cent of the general 50-year average.

The source of our rain being the warm and moist air current which comes to us from between south and west, and which has been known since Dové's time as the *equatorial current*, it is natural to suppose that the frequency of this current for the seven months noted should have shown a variation parallel with that of the rainfall amounts.

Now such is not the case. It has varied in a thoroughly irregular manner, whereas from June to October, a season in which the amount of rainfall does not show a change of régime, the frequency of the *equatorial current* was notably greater before 1900 than after.

This inconsistency disappears if we take the ratio of the rainfall amount to the number of tri-hourly observations of the *equatorial current*.[14] The result is quite unexpected.

In the course of 50 years this ratio has brought out remarkably similar fluctuations in the two seasons under consideration, as shown by Figures 1 and 2.

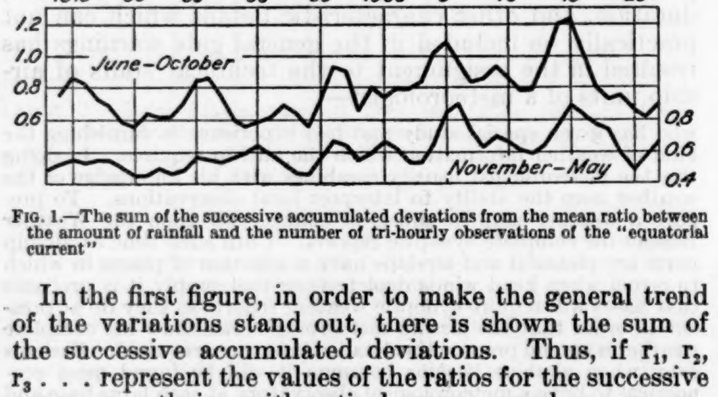

FIG. 1.—The sum of the successive accumulated deviations from the mean ratio between the amount of rainfall and the number of tri-hourly observations of the "equatorial current"

In the first figure, in order to make the general trend of the variations stand out, there is shown the sum of the successive accumulated deviations. Thus, if r_1, r_2, r_3 . . . represent the values of the ratios for the successive years, m their arithmetical mean, and $e_1 = r_2 - m$, $e_2 = r_2 - m$, $e_3 = r_3 - m$ . . . the deviations, then the sums of the accumulated deviations are successively e_1, $e_1 + e_2$, $e_1 + e_2 + e_3$ . . . . The sum is lowered if the deviations have a sustained tendency to be negative and is raised if they have a sustained tendency to be positive. When, as in the figure, each summer is plotted in relation to the immediately succeeding winter, the correlation between the two lines is at a maximum, reaching the value 0.96.

In general the ratio has varied from season to season with the amount of the October-March rainfall, having plainly oscillated about a lower value before 1900 than after that year. From what has just been said about the condition of maximum correlation it follows further that the modifications of the ratio begin to make themselves felt in summer before they do in winter.

In Figure 2 are set forth the same ratio values after smoothing by the usual process of doubling each value, adding to it the preceding and the following values and dividing the sum by 4. As in Figure 1, the parallelism between the two seasonal variations is almost perfect. There is to be noted, also, in the unsmoothed values of the ratio (not reproduced here for lack of space) a periodicity of 10 years length which is very clear.

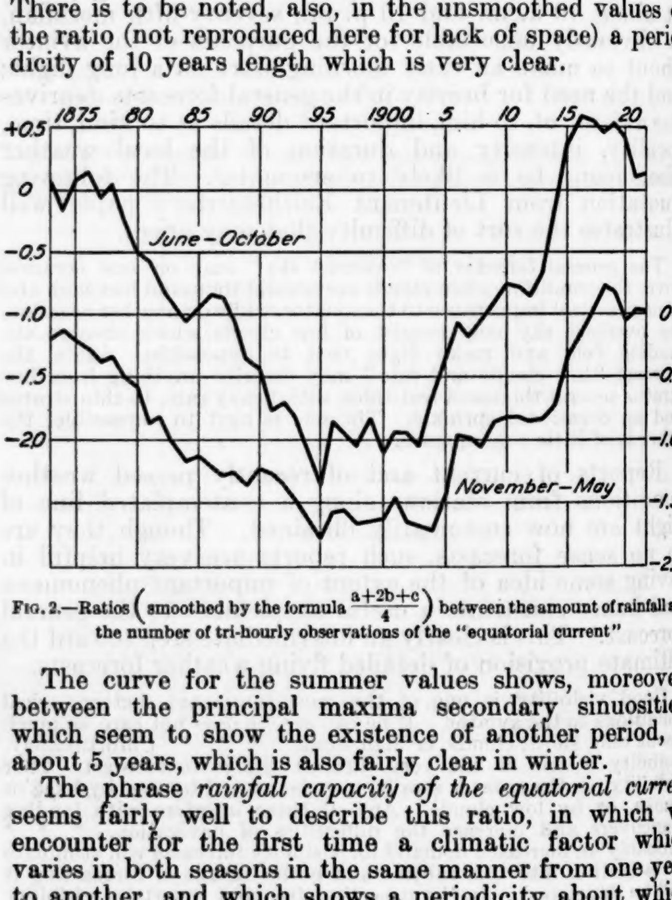

FIG. 2.—Ratios (smoothed by the formula $\frac{a+2b+c}{4}$) between the amount of rainfall and the number of tri-hourly observations of the "equatorial current"

The curve for the summer values shows, moreover, between the principal maxima secondary sinuosities, which seem to show the existence of another period, of about 5 years, which is also fairly clear in winter.

The phrase *rainfall capacity of the equatorial current* seems fairly well to describe this ratio, in which we encounter for the first time a climatic factor which varies in both seasons in the same manner from one year to another, and which shows a periodicity about which there can be no doubt.

[13] See Annales des Services techniques d'Hygiène de la Ville de Paris, 5, 1923, p. 194.
[14] At Montsouris it is customary to class under this designation the directions S., SSW., SW., and half of the directions SSE. and WSW.

NOTES, ABSTRACTS, AND REVIEWS

THE ART OF PLUVICULTURE

By DAVID STARR JORDAN

[Reprinted from Science, LXII, No. 1595, July 24, 1925, pp. 81-82]

It is remarkable, when we consider the varied attempts in our country to grow rich without risk or effort, that one of the most certain enterprises of this sort has been almost completely overlooked by trade schools, as well as by the Argus eyed press.

The professions of crystal gazing, clairvoyance, kleptomania, and the like, receive due attention from the press, as well as by the police, all efforts to benefit humanity by these means being everywhere discouraged. The ancient arts of astrology and horoscopy, however, have their quarter column in most of our leading papers, while the modern diversions of pluviculture, chiropractics, and hormonism are everywhere treated with respect.

Of these none can be more scientific than is pluviculture or rainmaking, as it is commonly called. Yet nowhere, so far as I have noticed, is the method of operation made clear, nor the economic laws which make it, not only valuable to the farmers, but a sure thing in general. Even the astute Father Ricard goes on with his prophecies, apparently oblivious to the work of other scientists right within the range of his storms and sunspots.

For successful rain making it is necessary to find first a region in which rain is expected but has failed to come. The first element is then to find a few hundred ranchers willing to give, let us say $8,000 to insure a storm, worth easily let us say $50,000 to them.

The pluviculturist has next to build a modest shack or to set up a tent for his chemical operations. Next he prepares certain chemicals in accordance with a secret formula. These may cost $50 more or less according to the likelihood of further demands for extension of his operations. What the formula is naturally no one has explained. Let me suggest a formula of my own. Take first 10 pounds of pulverized chlorate of potash and an equal amount of granular cane sugar. Mix these carefully in a wooden tub and when ready pour over them a liter (or pint) of sulphuric acid (c. p.). This simple and inexpensive preparation will produce surprising results. These may be brilliantly enhanced by using a pound of magnesium ribbon, to one end of which a lighted match has been applied, the whole sent into the air by attachment to a sky-rocket. This is most effective towards night or after clouds begin to form. Then certain salts of strontium yielding red light, barium yielding green, and other salts yielding lights of different colors, should be set on fire. That this formula of mine has been used by any professional rainmaker, I do not know. I am sure that any pharmacist might furnish something equally good. Some also use an old-fashioned fanning mill to condense the air, but that is less impressive.

Now that the chemistry has been provided for, the most important point follows—the economics of the process. There is an international institution known as "Lloyds" which insures anybody against anything, after a study statistical or meteorological of the chances. It charges a modest premium which naturally varies with the probabilities. If you want a clear day for a picnic or a football game, Lloyds will for a consideration insure you against rain. Lloyds do not control the weather, but while losing the premium charged you will receive enough to finance your pleasure or your sport next time. You can insure a baseball player against striking out, or an airship from falling into the sea, in accordance with scientifically accepted probabilities. Every well-regulated stadium or other center of culture is a client of Lloyds.

Now let the rain maker insure himself against a rainless day. I do not know the premium which Lloyds would charge. In California it would vary, being relatively low in March, especially in the north, rising higher to 100 per cent, or even more in July.

Let us suppose that a dry period should occur in March, the month of all months when rain is most desired in Coarse Gold, let us say, in Alcalde, and in Calexico. Let us take a high estimate, assuming that the premium charged is $2,000, on amount of insurance in case of a dry day being $8,000. The balance sheet of rain making is shown below:

A. In case of rain—

Received from the people of Alcalde	$8,000
Paid for chemicals and housing	50
Paid for premium to Lloyds	2,000
Balance of profit	5,950

B. In case of no rain—

Received from Lloyds	$8,000
Paid for chemicals and housing	50
Paid for premium to Lloyds	2,000
Balance of profit	5,950

C. In A, case of rain—

The people of Alcalde pay $8,000, and receive rain worth $50,000.

D. In B, case of no rain—

The people of Alcalde pay out nothing and receive nothing They are then ready to try again. The transaction thus involves therefore no loss to anyone except to Lloyds in case of B. And this great corporation knows how to recuperate elsewhere. But under A, of course, the people of Alcalde would have had their rain anyhow.

There is one element of risk. Once in San Diego County and once again in Fresno County the rain came as a desolating deluge, doing much damage and relatively very little good. It is said that under these conditions the cautious pluviculturist saw fit to take no chances and never collected his fee.

It was Barnum, was it not, who stated the lesson to be drawn: "A sucker is born every hour." Herbert Spencer insisted that "to save men from the consequences of their folly would fill the world with fools."

For this reason perhaps the press discourages crystal gazings and applauds the pluviculturist.

THE FLOODING OF A PASTURE BY HAIL

Many remarkable results of hailstorms have been noted in this REVIEW, but perhaps none more remarkable than that reported by Mr. Edwin T. Larsen, official in charge of the Weather Bureau Office at Charles City, Iowa. Three photographs, which, unfortunately, are not clear enough to warrant reproduction, show the extraordinary magnitude of the deposit.

These pictures were taken on the day following a severe hailstorm which occurred in southern Floyd County, Iowa, on June 11, 1925. The fall of hail was heaviest over the drainage area of a creek, known as Bloody Run, which enters the Cedar River 3 miles southeast of Charles City, Iowa. This creek bed is normally dry, but during the storm it carried a stream 20 feet deep and 100 yards wide. The hail, which was stated by the residents of the storm area to have fallen to a depth of 2 to 4 inches, was washed from the adjoining fields into the creek by a torrential fall of rain. The pictures were taken at a turn of the creek where the hail was carried out of the creek bed and deposited in an adjoining pasture, where a woven wire fence assisted in holding the hail until the water subsided. About 1½ acres were covered with hail to a depth of from 2 to 4 feet. The total precipitation during the storm can only be conjectured, but it was evidently considerably heavier than at the Charles City station, where 1.76 inches occurred, of which 1.60 inches fell in 50 minutes. Only a light fall of hail occurred at the station. The hailstones were said to have approximated hen's eggs or golf balls in size, and at the time the pictures were taken hail up to 2 inches in diameter could be readily found in the drift.

HAILSTORM OF SUNDAY AFTERNOON, MAY 24, 1925, AT BALTIMORE, MD.

By J. H. SPENCER

[Weather Bureau, Baltimore, Md.]

Following the hottest weather ever recorded at Baltimore in May (maximum temperature, 98°, at 3:30 p. m., 23d), the weather continued warm during that night, with a minimum temperature of 69°; then the temperature rose rapidly on the 24th to a maximum of 87° at 11:30 a. m. This was followed by a slight fall to 83° between 11:30 a. m. and 1:30 p. m., and at 1:30 p. m. a cool wave from Ontario struck Baltimore. Beginning at that hour the temperature fell 16° in about 10 minutes and 8° farther (a total of 24°) by 4:35 p. m., when the fall

of hail started. After the hailstorm the temperature fell steadily to a minimum of 43° at 8:15 a. m. of the following morning (25th).

For three and one-half hours preceding the storm the weather was unsettled and somewhat threatening during the greater portion of the time, and a trace of rain fell. About 20 minutes before the hail started to fall, at 4:35 p. m., the sky was black and threatening. At 4 p. m. a low whitish nimbus cloud was observed moving rapidly from the northeast, underruning the stratus in the northern sky and the strato-cumulus in the southern sky. By this time, 4 p. m., a very low, dark-brown cloud mass appeared in the southwest, with a tonguelike projection pointing toward the northeast. From the nimbus cloud a sprinkling rain began at 4:15 p. m., and changed to light rain at 4:30 p. m. Distant thunder was heard in the southwest, first at 3:50 p. m. Suddenly at 4:35 p. m., hail began to fall in great quantities, in attendance upon a wind gust from the southwest, which started at 4:32 p. m., and which changed to a moderate northwest wind seven minutes later.

Hail fell for four minutes, and the ground became as white as snow, so rapid was the fall. The heavy rain, which began at 4:39 p. m., quickly washed the hail from the streets and sidewalks, except where it was piled up against the windward side of houses and steps. Most of the stones were larger than mothballs, but they ranged from the size of peas and moth balls to small hickory nuts. They varied in shape as follows: Spherical, elliptical, sharp pointed, and disklike (the latter the size of a dime to a quarter). The hail fell straight down and not at an angle. The writer passed through the storm, in a street car, and none of the hailstones struck the windows.

The hailstorm swept over the city from west to east, therefore the time of beginning in the eastern part of the city was later than in the western. At the Weather Bureau office the hail began at about 4:35 p. m. Rainfall was excessive from 4:39 p. m. to 5:02 p. m., and the amount during this 23-minute period was 0.55 inch. Hail was washed by the heavy rain that followed from the surrounding neighborhood to a depth of 6 inches to a foot or more at the intersection of Charles and Lanvale Streets, and blocked street-car traffic at that point for 20 minutes, or until the hail could be shoveled off the tracks. At the northeast intersection of these streets the weight of the accumulated hail tore a basement door from its fastenings, and the basement filled with water and hail. Accumulations of hail such as this were due chiefly to the choking of sewers by leaves stripped from trees and also by hail. Hundreds of cellars were flooded, owing to the choked sewers.

Within the city hail stripped leaves off of trees and bushes and cut down flowering plants, rose bushes, etc. In country districts some damage resulted to wheat, corn, tomato plants, cabbage, truck crops, and to fruit on trees. Some poultry was killed.

Within the city some skylight and window panes were broken, while the breakage of greenhouse glass was more or less general. The conservatories in the city parks had thousands of panes of glass broken. About 1,200 panes of glass were shattered in the hothouses at Clifton Park. Florists in northeast Baltimore, just to the northward of Clifton Park, experienced the heaviest losses, but there were more windows broken in South Baltimore than elsewhere in the city.

The greatest accumulation of hail after the storm was found at Charles and Lanvale Streets, where it was washed into huge piles. The following day three 5-ton motor truck loads, twenty-two 3-ton motor truck loads, and fifteen 1-horse cart loads were hauled away from this vicinity.

It is impossible to estimate accurately the depth of hail that fell on the level, because of the torrential rain that swept it into the sewers within five minutes after the hailstorm started, but probably the depth was about 1 inch.

The area covered by the hailstorm was rectangular and about 12 miles wide by 18 miles long, extending from the extreme northern portions of Howard and Anne Arundel Counties northeastwardly across Baltimore City into southeastern Baltimore County. The northwestern edge of the hailstorm extended from near Ellicott City northeastward to about Fullerton; and the southeastern edge extended from near Rock Point northeastward to Bowleys Quarters, about 1 mile south of Bengies, Md.

Losses from the hailstorm are estimated at about $75,000, two-thirds of which was to greenhouse glass.

This storm created a sensation in Baltimore, due to the fact that it occurred over the heart of a great city. A similar hailstorm in country districts would have attracted comparatively little attention, but very likely would have caused greater money loss, due to the destruction of crops. The Forest Park, Walbrook, Roland Park, and Guilford sections of Baltimore were among the northern suburbs that escaped material damage from the storm.

A low-pressure area was directly over the Baltimore district on the afternoon of May 24, 1925. Lowest pressure was 29.38 inches at 4:30 p. m.

RIVER AND RAINFALL RECORDS IN AN IMPORTANT LAWSUIT

[Note from the official in charge, United States Weather Bureau Office, Nashville, Tenn., dated March 30, 1925]

The river and rainfall records of the Nashville station were important evidence in a rather unusual law suit[15] recently, in which a sand and gravel dredging company was sued by a riparian owner for dredging on his land at points a few miles below Nashville. The defendant claimed that he did not dredge on land above the "ordinary low-water mark," and was therefore within his rights.

It seems that the plaintiff had some years ago purchased the land and his deed called for the bank extending down to "extreme low water," although it has long been established by court rulings that in Tennessee riparian owners' property extends only to "ordinary low-water mark." Also, the plaintiff had purchased the property after the Government locks and dams had been built in the Cumberland River, which changed the line of "ordinary low water," raising it considerably.

The judge defined "ordinary low-water mark" in the following statement: "Although it is difficult to define with precision what is the ordinary low-water mark, it is a question of law and may be defined with sufficient accuracy to mean the usual and common or ordinary stage of the river when its volume of water is not increased by heavy rains or freshets, nor diminished below such usual stage or volume by long-continued droughts to an extreme low-water mark." Under this definition of the court and under all the evidence the judge stated, "the jury must find where that mark is in the river."

[15] Goodall v. Herbert et al.

The plaintiff claimed that what is known as pool level of the river, or the lowest stage to which the fixed dam will permit the water to fall (6.5 feet at Nashville), is ordinary low water. The defendant claimed that ordinary low-water mark is above the pool level some 6 or 8 feet, and attempted to prove this by the Weather Bureau records. A number of tables and charts prepared from Weather Bureau data were introduced as exhibits and from these what seemed to be periods of "ordinary" low water were pointed out. Principal among the data prepared were the average river stages and the average rainfall for the last 20 years, by months and seasons; five tables and charts showing the percentage of days in 20 years when the 7 a. m. river gage reading was at or above certain levels; a table and chart exhibiting all the dry spells (spells of 21 days or longer with 0.25 inch or less of precipitation) at Nashville, 1871 to 1924.

The verdict of the jury was in favor of the defendant, and was equivalent to saying that it had been shown that the "ordinary low-water mark" on the banks involved in the suit corresponded to 12 to 14 feet on the Nashville river gage. This would be 5.5 to 7.5 feet above minimum pool stage, which is 6.5 feet.

METEOROLOGY AND DESERT ROAD-BUILDING

The recently completed construction of the so-called "Wendover Cut-off," which consisted in part of a road fill some 40 miles long across Great Salt Lake Desert west of Salt Lake City, Utah, involved certain important adjustments of road-building methods to meteorological conditions, as suggested by the following extract from Engineering News Record of April 23, 1925.

* * * That portion of the cut-off of about 40 miles crossing the alkali mud flats and salt crust is all that called for unusual methods. This mud flat and the salt crust * * * are the sediment of a geological lake. The mud flat is about 80 miles long and half as wide. In this flat * * * is the island of salt, about 6½ miles wide where the road crosses. The salt crust varies from a few inches thick at the edges to 4 feet thick in the middle. In the summer, or the dry season, the water table over a large area is about at mud-surface level. In winter this area is covered with water up to a foot or so in depth, varying with the precipitation and as the winter is open or severe. This sheet of water shifts with the wind. A north wind of much duration will pile up the water at the south end of the "lake" and virtually lay dry the road location. With a shift of wind the piled-up water comes flooding back and submerges the highway location sometimes several inches deeper than normal. * * * The clay used in the embankment * * * was a very fine-grained material * * *. When this mass became saturated it held a considerable amount of moisture * * *. After the salt cuts were made and the underlying clay thrown up in windrows along the line of the embankment it took considerable time for the surface to dry out sufficiently to permit a caterpillar and grader to work upon it. The hot sun working on this mass for weeks would not dry it out to exceed a depth of a quarter of an inch. It was demonstrated that wind was more effective than the rays of the sun.

THE INCREASING RUNOFF FROM THE AVOCA BASIN (DUE APPARENTLY TO DEFORESTATION)[16]

By E. T. QUAYLE, B. A.

Formerly the stream bed of the Avoca River, a small stream in southeastern Australia near Melbourne, was characterized by many large water holes, many of which were 20 to 40 yards long, 10 to 15 wide, and 8 to 10 feet deep.

[16] Proc. Royal Soc. Victoria, Vol. XXXV, new series.

For 30 years, or up to the early nineties, the changes in the channel were not particularly noticeable, but during the last decade or two they have become very marked.

Changes in the vegetable cover of the basin began with the destruction by stock of the coarse grasses and trees which lined the river bed. With this destruction the cutting of the channel began. This gradually lowered the level of the water in the water holes and now, in most cases, has almost completely drained them. When the flow is rapid a fairly deep and uniform channel is eroded, but so far as seen by the author no lateral erosion has occurred.

Precise data as to the extent of timber cutting do not seem to be available. The author confines his remarks to what he has personally observed and he notes that "it is common knowledge in that district [the basin of the Avoca] that the clearing of the timber has most strikingly improved the summer flow of the stream by increasing the activity and duration of the springs."

He recalls the fact that a certain stream which was formerly dry for the greater part of the season is now a permanent stream; that even in April, 1922, it was discharging 5 c. f. per minute.

Statistics of the average minimum flow in c. f. s. for the 20 years 1890–1910 are compared with similar statistics for 1910–1919. This comparison shows that the average minimum discharge of the latter period is from two to ten times greater than formerly, while there has not been any special increase in the rainfall.

The official gaugings of the flow of the river over Coonooer wier show that the volume as well as the constancy of the stream flow is increasing greatly.—*A. J. H.*

METEOROLOGICAL SUMMARY FOR JUNE, 1925, FOR CHILE AND ARGENTINA

[Reported by Señor Julio Bustos Navarrete, El Salto Observatory, Santiago, Chile]

In June, 1925, the weather was rather rainy in the southern part of South America; there were two important periods of cyclonic disturbance—7th to 15th and 21st to 28th.

From the 1st to the 6th the atmospheric condition was characterized by the presence of a marked anticyclone over the south-central part of the continent, which caused severe cold waves invading the central valley of Chile as far as Santiago and the central pampas of Argentina as far as Cordoba. High pressure prevailed repeatedly over Argentina from the Province of Buenos Aires northward.

On the 7th an important depression was approaching from the west in latitude 45° south; on the following day it began to manifest its influence in the southern region, bringing strong winds and rain in the southern Provinces of Chile. Another depression appeared in latitude 40° south on the 10th, and on the next day its influence was shown in the occurrence of rain from Aconcagua southward to Chiloe. On the 12th the center of this low pressure area had moved to a position off Cabo Raper and during the next three days it advanced across the region of Magellanes in a course toward the South Shetland and South Orkney Islands and entered the frozen antarctic sea.

A rather important depression present in the Province of Rio Negro, Argentina, on the 10th was accompanied by rains extending southward as far as Puerto Madryn.

Between the 16th and the 20th an important anticyclonic center was formed in the south-central part of

the continent and as in the preceding case this brought a period of severe cold in Chile and Argentina.

On the 21st a cyclonic disturbance approached from the west in latitude 47° south, and on the 22d there followed another in latitude 37° south, a little to the south of the Juan Fernandez Islands, and then on the following day these two formations were separated by a region of relative high pressure with divergent winds in Chiloe. These formations united on the 24th to form a great cyclone in accord with the laws of Guilbert. During the period from the 25th to the 28th this cyclonic disturbance moved southward, its path passing near the South Shetland and South Orkney Islands into the antarctic sea. All of this period was characterized by heavy storms of rain and wind in southern Chile.

There was a rise in pressure and a return to the anticyclonic weather type during the last two days of the month.

ON THE CHANGES OF TEMPERATURE IN THE LOWER ATMOSPHERE, BY EDDY CONDUCTION AND OTHERWISE

By Prof. S. CHAPMAN, F. R. S.

[Reprinted from the Meteorological Magazine, March, 1925, pp. 34-35]

"It has long been recognized that the daily variation of temperature is due in the main to the heating of the atmosphere by the ground. The process is not completely understood, however. The temperature records which are kept at various heights on the Eiffel Tower provide material for investigating the flow of heat from one level to another. The material has been utilized by G. I. Taylor and by W. Schmidt. Professor Chapman is not satisfied that the results obtained by these workers tell the whole story, and he has made a closer analysis of the statistics. He finds that "eddy conductivity," the only agency considered by Taylor, will only account for half the heat which reaches the upper levels. The conclusion is that radiation plays a more important part than had been suspected. It was urged in the discussion that the methods adopted in the paper did not take account of convection. However that may be, it is clear that there is room for further study of the familiar phenomena of the daily temperature change."

THE HUMBOLDT CURRENT RETURNS TO NORMAL [17]

[Reprinted from Maritime Register of June 10, 1925]

Capt. George S. Dexter, of the Grace liner *Santa Luisa*, reports that the Humboldt Current is getting back to its normal position off the coast of South America after being temporarily shifted offshore by El Niño.

Birds and fish, however, are still fewer in number than formerly. Captain Dexter sailed from Valparaiso May 13, 1925.—*A. J. H.*

[17] See March, 1925, REVIEW, p. 116.

WEATHER BUREAU STAFF MEETINGS, 1924-25

The regular biweekly meetings of the scientific and technical staff of the Central Office of the United States Weather Bureau, initiated in the autumn of 1923,[18] were continued on the same plan during the winter of 1924-25.

The following is a list of the discussions that were held (asterisks denote speakers from outside the bureau):

September 4, 1924

*M. A. GIBLETT: The organization and work of the British Meteorological Office.

*J. BJERKNES: The forecast work of the Bergen Institute, Norway.

October 8, 1924

W. J. HUMPHREYS: Report on meteorological papers read before the Toronto meeting of the British Association for the Advancement of Science and the International Mathematical Congress.

W. R. GREGG: Report on the meeting of the National Aeronautical Association at Dayton, Ohio.

October 22, 1924

*S. J. MAUCHLY: Atmospheric Electricity.

November 5, 1924

*FRANK M. PHILLIPS: Atmospheric Conditions and Comfort.

November 19, 1924

H. H. KIMBALL: Report on the Madrid meeting of the International Union of Geodesy and Geophysics.

December 3, 1924

W. R. GREGG: A review of the recent investigations, by J. H. Field and W. A. Harwood, on the free atmosphere over India.

December 17, 1924

A. J. Henry: Hawaiian Rainfall.

January 14, 1925

*C. G. ABBOT: Results of the Solar Constant determinations at Mt. Harqua Hala, Arizona, and Mt. Montezuma, Chile.

January 28, 1925

*L. W. Austin: Atmospheric disturbances of radiotelegraphy.

February 11, 1925

*F. B. LITTELL: Observations of the total eclipse of January 24, 1925, made from the dirigible *Los Angeles*.

*H. L. CURTIS: Observations of the shadow bands during the total eclipse of January 24, 1925.

W. J. HUMPHREYS: Observations of shadow bands during the total eclipse of January 24, 1925, communicated to the United States Weather Bureau.

February 25, 1925

A. J. HENRY: How shall we define a "cold winter"?

E. W. WOOLARD: The mean variability in random series.

March 11, 1925

C. F. MARVIN and H. H. KIMBALL: The alleged fluctuations of the intensity of solar radiation, and their correlation with the weather.

March 25, 1925

W. W. REED: Foreign Climatic Statistics.

April 8, 1925

*W. ELMER EKBLAW: Northwest Greenland.

April 22, 1925

W. J. HUMPHREYS: Colloidal Meteorology.

May 13, 1925

F. G. TINGLEY: Ocean Temperature Data as collected by the U. S. Weather Bureau.

May 27, 1925

C. F. MARVIN: Present status of the problem of solar radiation and weather forecasting.

Discussion, both formal (prepared beforehand) and informal, followed the presentation of all the above papers.

—*Edgar W. Woolard, secretary.*

[18] See MONTHLY WEATHER REVIEW, 1924, 52: 35-36; 166.

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING JUNE, 1925

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1924, 52 : 42 and January, 1925, 53 : 29.

From Table 1 it is seen that solar radiation intensities averaged slightly above normal values for June at all three stations.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged above normal at the three stations for which weekly normals have been computed.

At Washington skylight polarization measurements made on 8 days give a mean of 49 per cent, with a maximum of 60 per cent on the 10th. At Madison, measurements made on 6 days give a mean of 58 per cent with a maximum of 62 per cent on the 23d. These are close to normal values for June at Madison and slightly above at Washington.

TABLE 1.—*Solar radiation intensities during June, 1925*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	[1]1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 2	15.11					1.21					14.60
3	17.37			0.60	0.86	1.14					19.89
5	17.37				0.64	1.11					14.10
10	17.96			0.71	0.99	1.36	1.11				10.21
11	6.27					1.41					6.76
12	8.18					1.24					8.81
15	17.96			0.71	0.95						17.37
19	12.68			0.76	0.95						12.68
20	11.81		0.52	0.70	0.93						11.38
22	11.81		0.61	0.79	0.99						9.83
26	11.81		0.60	0.77	0.99	1.27					11.38
Means			0.58	0.72	0.91	1.25	(1.11)				
Departures			−0.03	+0.01	+0.03	+0.04	+0.20				

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during June, 1925*—Contd.

[Gram-calories per minute per square centimeter of normal surface]

Madison, Wis.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 6	13.61				0.93	1.19					15.11
8	14.10				1.18	1.41					9.83
9	9.47				1.20	1.39					8.18
10	6.76		0.99	1.08							7.29
13	11.38				1.18						14.10
16	10.21					1.37					19.23
18	13.13				1.19						11.81
20	13.13				1.18	1.38					13.61
23	9.14				1.19	1.42					10.59
29	8.18				1.23	1.42					7.57
Means			(0.99)	(1.08)	1.16	1.37					
Departures			+0.11	+0.11	+0.06	+0.05					

Lincoln, Nebr.

Date	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
June 4	15.11				1.08						17.37
5	14.60		0.79	0.93	1.10	1.31					14.10
6	10.97		0.75	0.91	1.10	1.33					13.13
8	7.87		1.01	1.14	1.31						7.57
19	16.20						1.14	0.99	0.88		14.10
25	10.21		0.98	1.11	1.26						8.81
26	13.13					1.34	1.12	0.94			10.21
29	10.21			0.87	1.09	1.35					9.47
Means			0.88	0.99	1.16	1.33	(1.13)	(0.96)	(0.88)		
Departures			+0.12	+0.07	+0.08	−0.02	+0.04	+0.06	+0.12		

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation					Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Washington	Madison	Lincoln
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
June 4	535	634	677	536	472	+41	+137	+137
11	553	502	483	480	543	+59	−8	−70
18	445	561	476	454	548	−49	+38	−97
25	577	607	676	530	397	+86	+73	+89
Excess since first of year on July 1, 1925						+924	+2,114	+406

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

The following table shows the average sea level pressure for the month as well as the highest and lowest readings at a number of land stations on the coast and islands of the North Atlantic. The readings are for 8 a. m. 75th meridian time, and the departures are only approximate, as the normals are taken from the Pilot Chart and are based on Greenwich mean noon observations, which correspond to those taken at 7 a. m. 75th meridian time.

Station	Highest pressure	Date	Lowest pressure	Date	Average pressure	Departure
St. Johns, Newfoundland	30.24	28	28.80	17	29.83	−0.14
Nantucket	30.36	13	29.74	23	29.97	−0.03
Hatteras	30.26	4, 29	29.84	19	30.06	+0.05
Key West	30.10	25	29.96	12, 13, 16	30.02	+0.02
New Orleans	30.16	30	29.92	7, 8	30.03	+0.08
Swan Island	29.98	20	29.78	3	29.86	−0.01
Turks Island	30.12	20	30.00	2, 3	30.06	+0.05
Bermuda	30.44	29	30.06	7, 8	30.23	+0.13
Horta, Azores	30.48	2	29.82	8	30.24	+0.01
Lerwick, Shetland Islands	30.42	8	29.52	16	30.04	+0.24
Valencia, Ireland	30.44	10	30.02	29	30.22	+0.22
London	30.42	10	29.90	21	30.12	+0.19

The North Atlantic HIGH was apparently about normal in intensity, but during the first half of the month its crest was considerably west of its position as shown on the Pilot Chart. High pressure prevailed off the coast of Europe during the greater part of the month, and the Icelandic LOW was evidently less active than usual.

The number of days with winds of gale force was considerably in excess of the normal as shown on the Pilot Chart, over the middle section of the steamer lanes, where most of the heavy weather occurred in the first decade of the month. Gales were also more frequent than usual over the region between the 40th parallel and Newfoundland. Moderate weather was apparently the rule in the waters adjacent to the European coast as well as in the territory south of the 35th parallel.

Fog was unusually prevalent over the entire ocean, the greatest amount occurring in the squares between the 40th and 45th parallels and the 65th and 70th meridians, where it was reported on 19 days. Fog was also observed on from 7 to 8 days over the eastern section of the steamer lanes and on 3 days in the vicinity of the Azores.

The Dutch S. S. *Magdalina*, from Pensacola to Buenos Aires, reported unusually strong trade winds, force 7, from the 2d to 4th between the limits 14° N., 60° W., and 12° N., 55° W.

On the 2d there was a depression central near 53° N., 35° W. that moved slowly eastward, and from the 3d to 6th the middle and eastern sections of the steamer lanes were swept by moderate to strong gales as shown by Charts VIII to XI.

On the 7th there was a low central near 50° N., 35° W. that moved but little during the next three days, and on the 10th apparently curved sharply toward the northeast, decreasing in intensity. On the 7th the storm area extended as far south as the Azores, where southwesterly winds of gale force prevailed, accompanied by fog.

On the 8th moderate to strong gales were encountered between the 35th and 55th parallels and the 20th and 45th meridians, although on the latter date a number of vessels within these limits reported light to moderate winds.

From the 10th to 15th there ensued a period of comparatively calm weather over the entire ocean, except that on the 13th there was a slight disturbance over a limited area between the 40th and 45th parallels and the 30th and 40th meridians.

The British S. S. *Navarino*, from Norfolk to Barbados and return, reports as follows:

On June 11 at 10 a. m. (local time) in 35° N., 73° 40′ W. sighted a large waterspout about 10 miles to the NW. It appeared to be traveling NE., and was intact when last seen at 11 a. m.

On the 16th there was a depression over Newfoundland that developed into a severe disturbance and on the 17th the region between the 35th and 45th parallels and 45th and 65th meridians was swept by heavy gales. This LOW remained nearly stationary near Newfoundland until the 21st when it apparently moved northeastward, filling in on the way. On the 18th moderate winds were the rule over this region, but on the 19th southwesterly gales prevailed between the 35th parallel and Newfoundland, while on the 20th reports of winds of gale force were received from vessels in the easterly quadrants.

The American S. S. *Esparta*, Port Limon to Boston, reports as follows:

On Sunday, June 21, at 5.55 p. m. when 9 miles off Molasses Reef (25° N., 80° 30′ W.) there set in a heavy wind and rain squall. Wind NW., force 10; barometer, 30.14 inches; temperature of air, 74°.

At 7 p. m. squall passed in direction of Bahamas.

Tuesday, June 23, 3 p. m., 14 miles NE. Diamond Shoals light vessel, there set in a wind and rain squall. Wind WNW., force 10; barometer, 29.94 inches, temperature of air, 70°. Squall passed out ESE.

Both squalls were accompanied by sharp thunder and vivid lightning.

On the 23d and 24th there was a well developed depression over Newfoundland and at the time of observation on both of these dates vessels in the southerly quadrants reported moderate winds that later in the day increased to gale force.

On the 24th the trade wind off the south coast of Haiti was unusually strong, a force of 7 being recorded.

On the 25th there was a LOW off Hatteras that moved rapidly northeastward and on the 26th was central near Father Point, Quebec. On both of these dates southerly gales were encountered between the 35th and 45th parallels, west of the 60th meridian.

On the 28th vessels near the American coast between Hatteras and Nantucket reported southwesterly winds of moderate gale force, accompanied by comparatively high barometric readings and fog.

On the 29th unusually strong trade winds were reported between Jamaica and the Canal Zone.

At the time of observation on the 30th moderate weather was the rule over the entire ocean, although the American S. S. *Eastern Victor* encountered a westerly gale later in the day, as shown in table.

OCEAN GALES AND STORMS JUNE, 1925

Vessel	Voyage: From—	Voyage: To—	Position at time of lowest barometer: Latitude	Position at time of lowest barometer: Longitude	Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
North Atlantic Ocean			° ′	° ′				Inches				(1)	
Bay State, Br. S. S.	Belfast	New York	55 20N.	8 20W.	May 30	Mid. 30th	June 5	28.99	W	W	WSW	12	Steady W.
Baron Wemyss, Br. S. S.	Spain	Newfoundland.	45 44N.	32 00W.	June 2	6 a., 2d	4th	29.90	SW	SW., 7	WNW	WNW., 10	W.-SSW.
Caronia, Br. S. S.	Queenstown	New York	45 44N.	35 26W.	2d	1 a., 3d	3d	29.67	WSW	WSW., 8	NW	10	WSW.-W.
Montrolite, Br. S. S.	Moss, Norway.	do	56 00N.	24 40W.	2d	4 p., 4th	5th	29.20	S	SW., 10	SW	SW., 10	SSW.-WSW.
Montpelier, Am. S. S.	Hamburg	Philadelphia	46 50N.	29 40W.	5th	Noon 6th	6th	29.09	SSW	SSW., 8	SW	SSW., 8	SSW.-S.-SW.
Brush, Am. S. S.	Rotterdam	New Orleans	37 45N.	32 50W.	6th	4 a., 8th	9th	29.69	SW	SW., 8	W	SW., 8	Steady.
Hessen, Ger. S. S.	Colon	Hamburg	45 30N.	31 47W.	8th	10 a., 8th	9th	29.42	WSW	WSW., 10	SW	SW., 10	
West Modus, Am. S. S.	Dundee	Houston	54 31N.	18 44W.	8th	3 a., 9th	10th	29.72	SE	SSE., 3	SW	8	SSE.-SSW.
Hatteras, Am. S. S.	New York	England	40 30N.	57 35W.	16th	6 p., 16th	17th	29.35	S	SW., 9	NW	SW., 10	SW.-NW.
Andalusier, Belg. S. S.	do	Antwerp	41 30N.	56 40W.	16th	1 a., 17th	18th	29.15	SW	SW., 12	WNW	SW., 12	
Baron Sempill, Br. S. S.	Fowey	Philadelphia	43 32N.	55 21W.	19th	8 a., 19th	19th	29.33	SW	SW., 8	W	SW., 9	SW.-W.
Carlier, Belg., S. S.	Antwerp	New York	41 55N.	52 45W.	23d	10 p., 23d	24th	29.94	SSW	SSW., 11	WSW	SSW., 11	SSW.-WSW.
Sixaola, Am. S. S.	New York	Colombia	37 15N.	74 04W.	25th	6 a., 25th	25th	29.88	SSW	SSW., 5	SSW	8	Steady.
Kongosan Maru, Jap. S. S.	Limerick	Norfolk	39 25N.	63 31W.	25th	3 a., 26th	26th	30.08	SSW	SSW., 8	SSW	SSW., 8	Steady.
Eastern Victor, Am. S. S.	Antwerp	Philadelphia	46 31N.	31 48W.	30th	10 a., 30th	July 1	30.12	WSW	W., 6	WNW	NW., 8	W.-NW.
North Pacific Ocean													
Walter A. Luckenbach, Am. S. S.	San Pedro	Balboa	13 30N.	94 30W.	2d	4 p., 3d	4th	29.53	E	E., 7	SSW	E., 7	ENE.-ESE.
Margaret Coughlan, Br. S. S.	Port Alberni	do	13 30N.	93 30W.	4th	8 p., 4th	5th	29.50	N.byE.	N. by E., 8	S. by W.	SW., 9	N., N. by E. SW.
W. H. Tilford, Am. S. S.	San Pedro	do	14 00N.	94 30W.	5th	5 a., 5th	5th	29.57	NW	NW., 7	W	W., 9	NW.-W.
China Arrow, Am. S. S.	San Francisco	Taku	36 50N.	165 30W.	7th	2 a., 8th	8th	29.66	SE	SSE., 8	W	SSE., 8	SSE.-SW.-W.
Bolton Castle, Br. S. S.	Panama	Yokohama	29 50N.	156 50E.	9th	11 a., 9th	10th	29.64	S	SW., 10	E	SW., 10	E. - S. - SW. - WNW.-N.-E.
Makaweli, Am. S. S.	Hawaii	San Francisco	36 55N.	125 40W.	11th	9 p., 11th	12th	29.94	NW	NW., 8	NW	NW., 8	Steady.
Enterprise, Am. S. S.	do	do	37 26N.	123 48W.	13th	3 p., 13th	13th	29.82	NW	NW., 9	NW	NW., 9	Steady.
Kaga Maru, Jap. S. S.	Yokohama	Victoria	49 52N.	167 36E.	22d	4 p., 22d	25th	29.40	SSE	SSE., 8	SSE	SSE., 8	Steady.
Canadian Inventor, Br. S. S.	Balboa	do	39 08N.	124 05W.	26th	4 p., 27th	28th	29.97	NW	NW., 8	NNW	NW., 8	Steady.
Canadian Prospector Br. S. S.	Vancouver	Montreal	15 00N.	95 34W.	28th	4 p., 28th	29th	29.80	ENE	NE. by N., 7.	N	N., 8	ENE.-NE.-N.
President Grant, Am. S. S.	Seattle	Yokohama	43 17N.	155 10E.	29th	8 p., 29th	30th	28.85	ESE	SE. by S.	SW	SW., 9	SE. by S.-SW.
Broad Arrow, Am. S. S.	Hongkong	San Pedro	35 35N.	141 35E.	29th	6 p., 29th	29th	29.60	SE	ENE., 7	ESE	NE., 8	SE.-NE.-E.
South Pacific Ocean													
Makura, Br. S. S.	Sydney	Wellington	35 00S.	155 01E.	18th	4 a., 19th	20th	30.51	E	E., 7	ESE	E., 8	E.-ESE.
Do	Wellington	Raratonga	39 20S.	178 45E.	24th	8 a., 24th	25th	29.86	N	N., 8	NE	NNE., 9	N.-NNE.
Indian Ocean													
Defender, Br. S. S.	Mauritius	Calcutta	17 36N.	87 10E.	27th	4 p., 27th	27th	29.51	SW	SW., 6	SW	WSW., 8	W.-SW.

[1] Highest force of wind on June 4–5.

NORTH PACIFIC OCEAN

By F. G. Tingley

The weather of the North Pacific Ocean exhibited no unusual features during June so far as disclosed by a somewhat general survey of conditions. As may be expected at this season, pressure distribution shows relatively little variation from day to day and gales are infrequent. The month under consideration was typical in these respects. Pressure gradients for the most part were moderate and the highest wind force reported by any vessel was 10. Numerous reports of fog were received from the western section of the northern steamship routes, but few from other parts of the ocean.

The anticyclone which normally occupies the region northeast of the Hawaiian Islands was well developed throughout the month, except from the 9th to 11th, when there was an encroachment of low pressure from the northwest. During this period the lowest pressure of the month was recorded at Dutch Harbor, 29.22 inches. During the last half of June pressure was also consistently high in middle latitudes of the central part of the ocean. On the 18th and 19th vessels north and northwest of Midway Island reported readings as high as 30.52 inches. This high pressure appeared to advance from the region of Kamchatka and its eastward movement caused a reinforcement of the semipermanent area north of Hawaii, where readings of 30.40 inches or more were reported on several days. The crest of high pressure in this region in June is normally a little more than 30.25 inches.

Pressure data for the several island stations in the eastern North Pacific, as well as for a few stations on the American coast, are given in the following table:

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
Dutch Harbor [1]	29.86	−0.13	30.40	22d	29.22	10th.
St. Paul [1]	29.89	0.00	30.40	22d	29.34	11th.
Kodiak [1]	29.89	−0.05	30.34	24th	29.40	10th.
Midway Island [1]	[2] 30.02	−0.05	30.16	14th [3]	29.82	9th.
Honolulu [4]	30.04	0.00	30.13	6th	29.93	23d.
Juneau [4]	29.97	−0.04	30.40	24th	29.70	2d.
Tatoosh Island [5]	30.05	+0.03	30.38	23d	29.62	2d.
San Francisco [5]	29.92	−0.04	30.08	19th	29.70	12th.
San Diego [5]	29.90	−0.02	30.05	18th	29.74	27th.

[1] P. m. observations only.
[2] 29 days.
[3] And other dates.
[4] A. m. and p. m. observations.
[5] Corrected to 24-hour mean.

In the Hawaiian area the weather was dominated by the Pacific anticyclone to the northward as was the case in the preceding month. At Honolulu the prevailing wind direction was east, this direction being recorded in 602 hours out of 720. The highest velocity was 33 miles (from the east) on the 28th. The average velocity was 10.6 miles an hour. The rainfall at Honolulu continued to be below normal. The total amount for the month was

0.28 inch, or 0.64 below normal. The rainfall here since January 1 totals only 8.53 inches, 6.97 inches below normal.

Few disturbances of importance occurred during the month. The first to be reported was a small one off the Mexican coast, south of the Gulf of Tehuantepec, which was felt on the 3d to 6th by vessels on the California-Panama route. Its cyclonic character and small size are indicated by the reports of the steamships *Margaret Coughlan* and *W. H. Tilford*, which were in close proximity on the morning of the 5th, southward bound. At 5.40 a. m. (L. M. T.) the former was in 14° 10′ N., 94° 50′ W., the latter in 14° 15′ N., 95° 00′ W. At this hour the *Margaret Coughlan* had a north-northeast wind, force 8; barometer, 29.52. The *W. H. Tilford* had a west wind, force 9; barometer, 29.57. Data for this disturbance are too meager to permit of plotting a path or determining the rate of movement. It is evident, however, from the report of a third vessel, the S. S. *Walter A. Luckenbach*, that the center did not move far between the 3d and 5th. This vessel passed over the same route, also southward bound, two days earlier than the vessels previously mentioned and experienced in the same vicinity overcast, squally weather and rough seas. At 4 p. m. of the 3d the barometer had fallen to 29.53, wind east, 7. This was near 13° 30′ N., 94° 30′ W. Later the wind veered to SE., continuing from that direction until the morning of the 4th, when it went to S. and SSW., diminishing to force 3.

From the 7th to 9th vessels in the western part of the ocean experienced moderate to fresh southerly and westerly gales, associated with a depression which was then advancing toward the Aleutians and which contributed to the low pressure already mentioned as obtaining in midocean on the 9th to 11th.

On the 27th to 29th vessels east of Japan experienced moderate to strong gales, which seem to have been occasioned by a disturbance that was over northern Japan on the 27th and 28th, and which moved thence in a northeasterly direction. At 8 p. m. on the 29th the barometer on board the S. S. *President Grant*, in 43° 17′ N., 155° 10′ E., fell to 28.85 inches. The highest force of wind experienced by this vessel was 9 (SW.).

The S. S. *President Pierce* was involved to some extent in this disturbance. Mr. J. B. Zimmerman, third officer and observer, states that it occasioned an unusual sky display on the 27th. The following is taken from his report:

> As the sky cleared in the afternoon a magnificent display of clouds came to view. Sky was bright blue to deep blue overhead. Close to the surface raced detached patches of cumulus clouds from NW. to SE. Above them, SSE. to NNW., traveled another set of broken shreds of clouds, and high aloft, slowly converging from NNW. to a point of the horizon bearing SSE. streamed cirro-cumulus and cirrus clouds. At sunset the sight was beyond description. A rosy sunset with all the colors imaginable and the most perfect forms of cirrus clouds I have ever seen.

Other gales reported as occurring at various times during the month are recorded in the accompanying table.

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

"Warm and dry" best characterizes the weather of the month, the important exception being in the Missouri and upper Mississippi valleys and New England where the precipitation was greater than normal. An unusual, for June, hot spell persisted in central and eastern districts during the first 10 days of the month.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. Day

Low-pressure areas were about normal in number. Several of the more important storms developed over the southern Rocky Mountain region or the Southern Slope, although the associated katalabars were sometimes first noted on the Pacific coast.

The high-pressure areas were about normal in number, and about equally divided between the so-called Alberta and North Pacific types. The high of the 9th–12th, which brought an end to the warm wave of the first decade, was apparently built up behind the preceding low merely by the inrush of the cooler and hence denser air near the surface in its rear, and on this account was quite shallow as indicated by airplane observations of temperature secured at Washington on the morning of the 11th. There was a decided lapse in temperature up to about 1,200 meters as compared with the preceding day; but above this elevation a strong inversion existed with no change in temperature. It is also interesting to note that this shallow wedge of cold air underrunning warmer air aloft was not accompanied by precipitation within a radius of more than 200 miles of Washington. Thus the real break in the heat wave over a wide territory came with fair weather.

FREE-AIR SUMMARY

By V. E. Jakl

Table 1 shows a well-marked positive departure in temperature at Broken Arrow, Due West, and Groesbeck, and a similarly well marked negative departure at Ellendale. At Broken Arrow, Due West, and Ellendale the departures diminished with altitude, indicating that the contrast in temperature between the northern and the southern stations was, to a larger degree than normal for the month, greater in the lower levels than in the upper. Table 2 shows that at Ellendale the winds up to about 2,000 meters had a northwesterly component instead of the southwesterly directions normal for the month. Otherwise there were no important free-air departures in the various averages for the aerological stations.

The departures in temperature and wind at Ellendale are significant in connection with the unusual amount of precipitation at that station. In order to emphasize the distinguishing feature of the free-air conditions in their bearing on this precipitation comparison will be made with the aerological record at Due West, where the precipitation was distinctly deficient. The comparison supports a conclusion brought out in last month's (May, 1925) free-air summary, viz, that in so far as temperatures within the usually observed range of altitude are concerned high lapse rates are not necessarily the precursors of precipitation; also that when lapse rates equaling the dry adiabatic occur they are by no means always productive of heavy or even measurable amounts of precipitation.

Note should be made of the average lapse rate at Ellendale and Due West in Table 1, where, from 500 meters to 3,500 meters, Due West has a rate of 0.73°, and Ellendale, 0.52°. From individual observations and

the record of surface temperatures it is apparent that at Due West a lapse rate equaling or closely approaching the dry adiabatic, and extending to probably 3,000 meters, was undoubtedly effected in the majority of the afternoons during the month. As might be expected from such an unstable condition, thunderstorms occurred at Due West on 15 days, with a trace or more of rainfall on 16 days, but the total precipitation for the month was only 1.73 inches, or less than half the normal amount. At Ellendale, however, as a result of 12 thunderstorms and 13 days with measurable rain, a total of 11.81 inches was recorded, or about three times the normal amount.

In looking for a cause for these contrasting conditions at the two stations it appears that Due West was largely under the influence of high or moderate pressure, so that most of the showers were of a local convectional nature and were, furthermore, incapable of causing much precipitation, notwithstanding the high lapse rate, owing to lack of circulation from sources of moisture. On the other hand, Ellendale is found to have been dominated by a succession of troughs of low pressure that extended southward well toward the Gulf, alternating with, or affecting Ellendale in connection with, cool HIGHS that moved along the northern border. The latitudinal contrast in surface temperature over the territory contiguous to Ellendale (Chart III, this REVIEW) and in the free-air (Table 1), shows that Ellendale was frequently in a position favorable for severe thunderstorms of wind-shift line and other cyclonic types.

The following record taken from the observations at Ellendale on the 23d and Due West on the 24th have been selected to illustrate the widely divergent vertical air structure typical of the month at the two stations. The Ellendale observation, which shows a variable lapse rate, averaging 0.47° per 100 meters from the ground to the highest level, can be taken as closely representing the conditions during the prevalence of rain, inasmuch as the observation was overtaken by a storm, during which 0.84 inch rainfall occurred; while at Due West on the 24th, where the observation shows a lapse rate averaging about the dry adiabatic and incipient condensation in the uppermost levels, the conditions were not productive of rain until about four hours later, when only a trace fell.

Altitude m. s. l. (meters)	Due West, S. C. Altitude, 217 meters. June 24, 1925				Ellendale, N Dak. Altitude, 444 meters. June 23, 1925			
	Temperature	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity	Wind direction	Temperature	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity	Wind direction
	°C		Per cent		°C		Per cent	
Surface	36.0		32	W.	16.0		90	ENE.
500	32.2		31	W.	15.4	1.10	87	E.
1,000	26.2		36	W.	17.1	−0.34	55	SE.
1,500	20.8		47	W.	13.4		62	SE.
2,000	15.6		59	WSW.	9.7		69	SE.
2,500	10.6	1.11	71	WSW.	5.6		79	SE.
3,000	6.7		82	WSW.	5.3		93	SSE.
3,500	2.8	.78	98	W.	1.6	.62	93	SSE.

Wind observations by means of both kites and pilot balloons show that the occasional periods of high temperature over southern and eastern sections were accompanied by light free-air winds, particularly in the higher altitudes. This is well shown by the records at Groesbeck, where, with temperatures close to 100° F. on most days, the winds showed very few exceptions to a general condition of light air movement at all levels above about 2,000 meters. Also at Washington the warmest day (5th) was attended by light variable winds in the lower levels and easterly in the upper to about 10,000 meters. The inference from this, to the effect that the observed high temperatures were almost entirely the result of insolation heating the ground and lower air layers, uninterrupted by precipitation or invasions of cooler air from other sections, is confirmed by the kite observations at Broken Arrow on the 25th and 28th in the following table. These show the changes from one of the coolest days of the month, with a surface maximum temperature of 85° F. (29.4° C.) on the 25th, to the warmest day, with a surface maximum of 104° F. (40° C.) on the 28th. As the observations were not made at the same time of day on both dates, and the lower levels are therefore not strictly comparable, attention should be given principally to the temperatures above 1,000 meters, which show a gradually diminishing difference with altitude between the two dates until at 3,800 meters a reversal is noted, the temperature at that altitude being slightly lower on the 28th in a west wind than on the 25th in a north wind. By comparing the maximum surface temperature on the 28th, 40°, with the temperature at 3,800 meters, 2.7°, it is apparent that the heating in the lower levels that began on the 26th gradually extended to the upper levels until, at the time of maximum surface temperature on the 28th, a dry adiabatic lapse rate prevailed up to about 3,800 meters. This condition on the 28th evidently determined the high point of the warm period, because as the column of air having a dry adiabatic deepens it becomes increasingly difficult, owing to the rapid removal of the surface air by convection, for the surface temperature to rise further.

Altitude, m. s. l. (meters)	June 25, 1925		June 28, 1925	
	Temperature (° C.)	Wind direction	Temperature (° C.)	Wind direction
233 (surface)	26.7	N.	28.8	SSW.
500	22.6	N.	27.8	SW.
1,000	17.7	N.	25.6	SW.
1,500	13.4	N.	22.3	SW.
2,000	11.0	N.	18.2	SW.
2,500	10.3	N.	13.7	WSW.
3,000	9.6	N.	9.2	WSW.
3,800	4.7	N.	2.7	W.

As usual for the time of year, winds of pronounced easterly component became increasingly frequent at most southern stations as the month advanced, so that Key West and San Juan showed resultant winds nearly due east at practically all levels, and Groesbeck southeast winds at the ground gradually backing with altitude to nearly east at 4,000 meters and above.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1925*

TEMPERATURE (° C.)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 m.)		Drexel, Nebr. (396 m.)		Due West, S. C. (217 m.)		Ellendale, N. Dak. (444 m.)		Groesbeck, Tex. (141 m.)		Royal Center, Ind. (225 m.)	
	Mean	Departure from 7-yr. mean	Mean	Departure from 10-yr. mean	Mean	Departure from 5-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 7-yr. mean	Mean	Departure from 7-yr. mean
Surface	27.9	+2.6	22.2	+0.7	28.7	+1.8	17.6	−1.6	28.1	+2.0	23.9	+0.6
250	27.7	+2.5			28.2	+1.7			26.9	+1.8	23.5	+0.5
500	25.6	+2.4	21.3	+0.5	25.2	+1.4	17.1	−1.8	24.4	+1.3	20.4	+0.1
750	24.0	+2.4	20.0	+0.7	23.3	+1.4	15.5	−1.8	22.7	+1.1	18.5	+0.2
1,000	22.3	+2.0	18.6	+0.6	21.5	+1.2	14.1	−1.8	21.2	+0.8	16.7	0.0
1,250	20.5	+1.5	17.4	+0.7	19.6	+1.0	12.8	−1.8	19.9	+0.7	14.9	−0.2
1,500	19.1	+1.5	16.1	+0.7	17.7	+0.9	11.8	−1.5	18.5	+0.5	13.5	−0.2
2,000	16.3	+1.6	13.8	+1.1	14.0	+0.6	9.5	−1.0	16.8	+1.1	10.4	−0.6
2,500	13.4	+1.5	10.9	+1.2	10.7	+0.6	6.9	−0.8	14.8	+1.6	7.1	−1.1
3,000	10.4	+1.6	8.0	+1.3	6.8	−0.3	4.4	−0.5	12.3	+1.7	3.7	−1.7
3,500	7.3	+1.7	4.8	+1.3	3.4	−0.6	1.5	−0.5	10.1	+2.1	1.1	−1.6
4,000	4.1	+1.6	2.0	+1.7			−1.2	−0.4	7.9	+2.6		
4,500	1.2	+1.7	−0.8	+1.8			−3.5	+0.4	5.1	+2.8		
5,000	−1.8	+1.4	−3.8	+1.9					2.4	+3.6		

RELATIVE HUMIDITY (*per cent*)

Altitude, m. s. l. (meters)	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	57	−14	68	−2	54	−7	74	+3	64	−9	62	−2
250	57	−14			54	−7			67	−7	62	−2
500	59	−13	68	0	56	−7	73	+3	73	−3	64	−1
750	61	−11	64	−1	58	−6	69	+1	74	−1	65	+1
1,000	63	−8	63	−1	61	−4	68	+1	71	0	66	+1
1,250	66	−4	62	−1	64	−2	67	+1	68	+1	66	0
1,500	64	−4	61	0	67	0	63	−1	67	+4	64	−1
2,000	57	−6	57	−1	69	0	61	−1	53	−2	69	+7
2,500	52	−5	57	+1	64	−4	60	+1	44	−7	67	+14
3,000	49	−4	50	−4	70	+4	57	+2	40	−7	71	+21
3,500	47	−5	50	−3	74	+10	54	+3	29	−15	48	+5
4,000	49	−1	50	−2			54	+7	25	−18		
4,500	48	+1	51	+1			40	−6	24	−22		
5,000			51	−1					23	−23		

VAPOR PRESSURE (*mb.*)

Altitude, m. s. l. (meters)	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	21.34	−1.56	18.28	+0.31	20.69	−0.58	15.17	−1.02	23.69	−0.76	18.25	−0.18
250	21.18	−1.52			20.19	−0.72			23.31	−0.27	17.78	−0.35
500	19.59	−0.77	17.29	+0.43	17.53	−1.02	14.58	−1.10	21.96	+0.38	14.97	−0.76
750	18.06	−0.32	15.07	+0.37	16.20	−0.70	12.45	−1.26	20.18	+0.67	13.71	−0.64
1,000	16.88	+0.20	13.64	+0.28	15.09	−0.44	11.14	−1.20	17.71	+0.64	12.85	−0.36
1,250	15.67	+0.78	12.47	+0.36	14.15	−0.12	10.09	−1.03	15.78	+0.76	11.83	−0.29
1,500	13.97	+0.78	11.45	+0.65	13.30	+0.26	8.84	−1.03	14.35	+1.24	10.58	−0.27
2,000	10.57	+0.43	9.08	+0.44	11.05	+0.32	7.35	−0.62	10.30	+0.33	9.51	+1.07
2,500	7.98	+0.51	7.55	+0.64	8.30	−0.18	6.17	−0.28	7.71	−0.18	7.48	+1.72
3,000	6.14	+0.56	5.46	−0.09	6.72	+0.15	5.07	+0.13	6.20	−0.12	5.64	+1.50
3,500	4.94	+0.52	4.21	−0.22	5.22	+0.18	3.94	+0.01	4.36	−0.75	3.06	+0.47
4,000	4.04	+0.56	3.55	−0.03			3.21	0.00	3.76	−0.52		
4,500	3.76	+0.98	3.00	+0.20			1.91	−0.64	3.53	−0.29		
5,000			2.54	+0.18					3.35	−0.03		

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The atmospheric circulation during the month, as disclosed by the chart of average sea-level pressure, assumed the usual summer type in the main—high pressure over the Southeastern States, moderately low values over the interior, and again high pressure along the Pacific coast. These conditions were accentuated, however, in each locality as compared with normal conditions; and notably the southeastern high was maintained with unusual strength and persistence during the first decade, resulting in an unusually long period of southerly winds, high temperatures, and lack of precipitation over the eastern third of the country. At the same time pressure was distinctly lower than normal over the central and southern Rocky Mountain and Plateau regions and thence northeastward to the Great Lakes. Numerous cyclones, usually of small proportions, however, formed over the Southwest, and unable to overcome the anticyclonic area overlying the Southeastern States, moved toward the upper lakes, bringing an usually large number of rainy days to the Missouri and upper Mississippi Valley districts, and much cool, cloudy weather throughout the Northwest.

The early part of the month likewise had generally low pressure over the Pacific Coast States, and cool, cloudy weather resulted, with usually more than the average precipitation in the far Northwest and in portions of California.

During the last half of the month pressure conditions were largely reversed. Anticyclones became more numerous over the far Northwest, temperatures increased, and a period of unusually dry atmospheric conditions prevailed. Low pressure was still more or less persistent along the Canadian border, and rather frequent showers continued in the Northern States east of the Rocky Mountains. At the same time the atmospheric circulation over the Southeastern States became less stable, weather changes were more frequent, with a decided tendency to moderate temperatures, and local showers relieved to some extent the need for moisture.

The high pressure over the Southeastern States during the early part of the month favored persistent southerly

TABLE 2.—*Free-air resultant winds (m. p. s.) during June, 1925*

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		7-year mean		Mean		10-year mean		Mean		5-year mean		Mean		8-year mean		Mean		7-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 7°W.	7.4	S. 4°W.	4.4	S. 2°E.	3.0	S.	0.1	S. 51°W.	2.4	S. 75°W.	1.1	N.47°W.	1.6	S. 30°W.	0.1	S. 2°W.	4.7	S. 5°E.	3.4	S. 55°W.	2.2	S. [illegible]°W.	1.4
250	S. 8°W.	7.4	S. 5°W.	4.5					S. 49°W.	2.2	S. 76°W.	1.2					S. 3°W.	5.1	S. 4°E.	4.0	S. 37°W.	2.4	[illegible]	1.5
500	S. 13°W.	8.6	S. 10°W.	5.8	S. 2°E.	3.6	S. 2°E.	2.3	S. 65°W.	2.8	S. 77°W.	1.9	N.61°W.	1.3	S. 31°W.	0.1	S. 7°W.	5.9	S. 1°W.	5.4	S. 49°W.	4.5	S. 48°W.	2.6
750	S. 17°W.	8.8	S. 14°W.	6.5	S. 13°W.	5.2	S. 10°W.	3.5	S. 65°W.	3.0	S. 74°W.	2.5	N.85°W.	1.2	S. 12°W.	0.9	S. 6°W.	6.3	S. 4°W.	5.8	S. 49°W.	6.2	S. 53°W.	3.5
1,000	S. 21°W.	8.6	S. 20°W.	6.6	S. 19°W.	6.1	S. 24°W.	4.0	S. 79°W.	3.1	S. 78°W.	2.5	N.78°W.	1.7	S. 26°W.	1.3	S. 3°W.	6.6	S. 8°W.	6.2	S. 58°W.	7.5	S. 67°W.	4.3
1,250	S. 27°W.	8.7	S. 26°W.	6.7	S. 28°W.	6.9	S. 34°W.	4.3	S. 89°W.	3.1	S. 82°W.	3.0	N.85°W.	2.3	S. 49°W.	2.0	S. 4°W.	6.7	S. 9°W.	6.5	S. 59°W	8.9	S. 72°W.	4.9
1,500	S. 27°W.	8.8	S. 30°W.	6.8	S. 37°W.	7.2	S 48°W.	4.8	W.	3.7	S. 86°W.	3.8	W.	3.0	S. 54°W.	2.4	S. 4°W.	6.8	S. 10°W.	6.0	S. 70°W.	6.0	S. 82°W.	4.8
2,000	S. 25°W.	8.2	S. 35°W.	6.7	S. 49°W.	9.7	S. 57°W.	6.1	S. 81°W.	4.4	S. 88°W.	5.7	N.89°W.	4.5	S. 65°W.	3.6	S. 6°W.	6.6	S. 12°W.	5.6	S. 79°W.	10.5	S. 82°W.	7.5
2,500	S. 29°W.	8.1	S. 36°W.	6.9	S. 66°W.	9.9	S. 70°W.	7.5	S. 72°W.	3.8	S. 87°W.	5.8	S. 71°W.	5.9	S. 71°W.	5.4	S. 1°W.	6.2	S. 14°W.	5.5	S. 69°W.	12.2	S. 80°W.	9.1
3,000	S. 28°W.	7.5	S. 37°W.	6.5	S. 73°W.	10.5	S. 76°W.	8.9	S. 80°W.	8.2	S. 88°W.	7.9	S. 71°W.	8.2	S. 78°W.	7.5	S. 4°W.	5.8	S. 16°W.	5.5	S. 67°W.	11.5	S. 82°W.	10.4
3,500	S. 42°W.	5.1	S. 44°W.	6.7	N.84°W.	12.6	S. 81°W.	9.5	S. 85°W.	11.7	S. 83°W.	9.0	S. 81°W.	10.1	S. 80°W.	9.3	S. 5°E.	6.6	S. 9°W.	5.8	S. 37°W.	8.7	S. 84°W.	11.1
4,000	S. 85°W.	6.2	S. 60°W.	7.1	N.86°W.	10.7	N.85°W.	9.0					S. 78°W.	13.2	S. 88°W.	11.6	S. 23°E.	7.0	S. 8°W.	6.4				
4,500	N.72°W.	8.6	S. 88°W.	8.0	S. 78°W.	12.4	N.79°W.	9.0					S. 62°W.	15.1	N.88°W.	12.7	S. 45°E.	10.1	S. 12°E.	8.2				
5,000	W.	13.0	N.73°W.	12.4	N.84°W.	12.3	N.58°W.	16.1					S. 45°W.	16.0	N.74°W.	14.6	S. 67°E.	10.0	S.	3.8				

winds in most districts from the Rocky Mountains eastward during that period, and with occasional favorable conditions for such winds thereafter, the prevailing directions for the month were mainly southerly over the eastern two-thirds of the country. No extensive severe storms occurred during the month, though local high winds and hailstorms were numerous, and caused much damage to crops and otherwise in the aggregate, particularly in Iowa and adjoining States. The loss of human life, however, appears to have been moderately small, though a considerable number of persons were more or less injured. The usual details concerning the severe storms of the month appear at the end of this section.

TEMPERATURE

The outstanding weather features were the long heated period over the more eastern districts during the first decade, and the similar conditions experienced in the far West about the middle of the last decade.

At the beginning of the month pressure was increasing over the Southeastern States, and a cyclone of considerable proportions had overspread the Dakotas, thereby inducing southerly winds over much of the eastern half of the country. This pressure distribution continued without material interruption during nearly the entire first decade, though the conditions were most favorable for intense heat from about the 4th to 6th over the Great Lakes, Ohio Valley, and thence eastward, where the day temperatures were in many localities the highest ever observed in June, and at others the highest so early in the season. From the 1st until about the 9th or 10th the temperatures over this region were almost constantly far above normal, and in some of the more eastern and northern sections the period as a whole was the hottest ever experienced so early in the summer, the departures from the normal ranging from +10° in portions of the Southern Plains to +15° or more locally in the Great Lakes region and the North Atlantic States.

During portions of this period high humidity existed and many prostrations and deaths resulted in the congested districts of the larger cities.

Over the western districts the period was moderately cool, the lowest temperatures of the month occurring in all the States from the Great Plains westward.

From the 10th to the 16th temperatures continued moderately high from the southern Plains northeastward to New England, but occasional changes to cooler brought much relief. Over most western and northwestern districts this period continued moderately cool.

For the period 16th to 23d temperatures were mainly above normal over the greater part of the country, though not oppressively so save in some interior sections from the middle Plains eastward and in the far West, where the averages ranged from 6° to 10° or more above normal. In parts of California and adjacent States decidedly warm weather set in toward the latter part of the period, some stations in northern California reporting the highest temperatures ever observed in June.

The last week of the month continued unusually warm over the far West, stations in central and northern California and generally in Oregon and Washington reporting not only the highest temperatures ever observed in June but the highest observed in any month during the past 50 years. This week was moderately cool over all districts from the Missouri Valley to the Atlantic coast, a few points in the Lake region having the lowest temperatures ever observed so late in the season.

The average temperatures for the month returned mainly to the above-normal conditions that have continued so persistently during the present year so far, except for May, the month being particularly warm from the middle and southern Plains eastward to the coast. In many of the Atlantic coast districts the monthly means were higher than any previous June of record, while in portions of the Ohio Valley they were the highest save for 1914. In the southern Plains the monthly means were locally the highest for June, or the highest except for June, 1911.

Maximum temperatures reached 100° or more in practically all the States, the highest observed, 123°, occurring in California, though 117° was observed in Arizona, 113° in Idaho, 112° in Nevada, and 110 in Oregon, Washington, Kansas, and Texas.

Minimum temperatures were below freezing at exposed points near the end of the month in all the northern border States from the Dakotas eastward. In the western districts and along the immediate Gulf and south Atlantic coast districts they were usually lowest during the first few days of the month.

PRECIPITATION

As has been the case for a number of months, precipitation was deficient and more or less scanty over the Atlantic and Gulf Coast States, portions of the lower Lake region and Ohio Valley, and in the southern Plains.

The first decade was mainly without beneficial rains from Oklahoma and Texas eastward to the Atlantic coast, and portions of the Ohio Valley and Middle Atlantic States also had but little. Over the northern districts this period had rather frequent showers; in fact, in portions of the Dakatos and adjacent States showers occurred almost daily and they were rather frequent in the western Mountain districts and the Pacific Coast States from northern California to Washington.

During the second decade frequent rains continued over many northern sections and extended southward into the middle Mississippi Valley, and local showers occurred in many eastern and southern districts. During this period some local heavy rains occurred, notably at Galveston, Tex., where on the 12th more than 10 inches fell in a comparatively short period, the heaviest rain by far recorded at that station in June, a rather peculiar feature of this storm being the limited area over which the rain was unusually heavy. On the 14th and 15th remarkably heavy rains occurred over northeastern Iowa; at Dubuque the fall was among the heaviest of record in 50 years. Much damage resulted from washing, flooding, etc.

The last decade had scattered showers over many districts, and most States from the Missouri Valley eastward had sufficient for present needs. In portions of the West Gulf and Southern Plains States there was little beneficial rain, and drought was becoming severe.

For the month as a whole and considering the entire country there was a considerable deficiency in precipitation, as had been the case in practically all the months of the present year. In general all States east of the Mississippi River had deficient rainfall, except the extreme Northeast and the sections bordering on the upper portions of that river. There was also a general and important lack of precipitation in the West Gulf and Southern Plains States and in the far Northwest. In portions of central and western South Carolina the month was among the driest of record for June, and similar conditions existed in portions of the lower Mississippi Valley, notably in western Tennessee and northern Louisiana,

where rainfall has been remarkably deficient for six months or more.

In large portions of Texas the month was without material rainfall, while in New Mexico severe drought for many months past still continued. At Roswell, N. Mex., the continued lack of rain had resulted in lowering the flow of water from artesian wells to unprecedented levels, and where they normally flowed spontaneously it has become necessary to resort to pumping and even that failed in many wells. Also at other points in that State the diminishing water supply was becoming serious.

On the other hand, precipitation was unusually heavy in the upper Mississippi Valley and portions of the Dakotas and adjacent States, and there was a general excess to the westward as far as the Plateau States and over California and Arizona. At a few points the monthly precipitation was the greatest of record, notably at Charles City, Iowa, while at other points in the northeastern portion of that State it was equal to or greater than had been previously recorded in June.

SNOWFALL

As far as available reports indicate, no snow occurred during the month east of the Rocky Mountains. In the high elevations of those mountains amounts up to 10 or 12 inches occurred, mostly in Colorado, Wyoming, and Montana, while light snows fell at points in the high mountains of California and Arizona.

RELATIVE HUMIDITY

Over nearly all central and eastern districts there was a general deficiency in the relative humidity, the negative departures from the normal being usually quite large from the southern Plains northeastward to the Appalachian Mountain region. In the Northern States from the Great Lakes to the Rocky Mountains there was a rather general excess of relative humidity, and similar conditions existed over many sections of the Rocky Mountain and Plateau States.

SEVERE LOCAL HAIL AND WIND STORMS, JUNE, 1925

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yard[1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Marlette, Mich. (near)	1					Tornado	Several farm buildings demolished	Official, U. S. Weather Bureau.
Bourne, Mass	1					Hail	Glass in windows and hothouses broken	Do.
Tieton City, Wash	1		2,640			do	Crops damaged	Do.
Mondovi, Wis	1	4-5 p. m.	880			Heavy hail	Severe crop damage	Do.
Junction City, Kans	1	4:30 p. m.	2,640		$20,000	Hail	Greenhouses and auto tops damaged; fruit and other crops injured.	Do.
Crawford County, Kans	1	do			100,000	Tornado	Schoolhouse and several dwellings wrecked; orchards and wheat fields damaged. Heaviest losses in Wier and Scammon. Four persons injured.	Official, U. S. Weather Bureau; Daily Capital (Topeka, Kans.).
Iowa (parts of)	1-3			10	([2])	Series of tornadoes, rain, hail.	Crop and property losses extensive; many persons injured. Heavy damage in Sioux City.	Tribune (Sioux City, Iowa); Official, U. S. Weather Bureau.
Methow, Wash. (vicinity of)	2	10 a. m.	1,760		75,000	Hail	Apple crop loss heavy	Official, U. S. Weather Bureau.
Lakeside, Wash. (vicinity of)	2	do	3,520		20,000-25,000	do	Apple orchards damaged.	Do.
Ionia, Mich. (near)	2	P. m.				Small tornado	Several barns, silos, and outbuildings wrecked; trees uprooted; houses moved from foundations. One person injured.	Free Press (Detroit, Mich.).
Minneapolis, Minn., and vicinity.	2	do		5		High wind	Building demolished; trees uprooted; a number of lives lost and a score of persons injured.	Official, U. S. Weather Bureau.
Madison County, Nebr. (South part of).	2	3 p. m.		3	$200,000-250,000	Tornado	Buildings on three farms completely destroyed, others damaged; 100 head of cattle, 25 horses, and thousands of chickens killed. Much crop damage over path 4 miles long.	Do.
Otoe and Cass Counties, Nebr.	2	3:30 p. m.	440-880		200,000	do	Everything in path wrecked; path 30 miles long; livestock killed.	Do.
McPherson County, Kans	2	3-4 p. m.	16-33		65,000	do	Damage chiefly to telephone lines and barns	
Riley and Pottawatomie Counties, Kans.	2	5 p. m.	50-100		35,000	do	Property and crops damaged; heaviest loss at Garrison.	Do.
Clark County, Wis. (southwest part of).	2	10:30 p. m.	65-100		30,000	do	Loss mainly to farm buildings; some damage to orchards and crops over path 20 miles long.	Do.
Brule, Wis	3	1 a. m.		1	2,500	Probably small tornado.	Amount and character of damage not reported	Do.
St. Joseph, Mo., and vicinity.	3	A. m.			500,000	Rain and wind	Heavy damage in city by flooding; considerable crop destruction; many bridges washed out.	Do.
Ludington, Mich., and vicinity.	3	11 p. m. midnight.				Thunderstorm	Buildings north and east of city damaged by lightning.	Do.
Omaha, Nebr	3					Thunderstorm and tornadic wind.	Roofs and porches damaged; small house moved from foundation.	Do.
Artesia, N. Mex. (near)	4	5:05-5:15 p. m.	880-1,760			Severe hail	Much glass broken	Do.
Manning, S. C. (near)	5	P. m.			9,000	Electrical and hail.	Church damaged at Jordan; barn destroyed; considerable crop loss.	Do.
Parke County, Ind. (east part of).	6				4,000	Electrical	Two barns destroyed	Do.
Wray, Colo. (near)	6	1:30 p. m.	1,760		100,000	Tornado	Many homes and farm buildings destroyed; stock killed; trees and telephone lines prostrated; path 22 miles long; 6 persons seriously injured.	Do.
Rockport, Mo	7	4 p. m.			7,000	Small tornado	Small outhouses, barns, and chimneys blown over; trees uprooted.	Do.
Ardmore, Okla. (near)	7	6 p. m.	100	1		Wind	One small residence demolished; two oil storage tanks moved; minor property damage.	Do.
Baltimore County, Md	8	3 p. m.	1,760		16,000	Thunderstorm and hail.	Damage principally to crops; tents of military camp blown down; trees uprooted; home under construction wrecked.	Do.
Cumberland, Md	8	7 p. m.			25,000	Electrical and heavy rain.	Heavy damage by rain	Do.
Mechanicsville, Md. (near)	8			1		Electrical	Several buildings damaged; 2 horses killed	Do.
Niles, Ohio	8					Wind and rain	Roofs blown off; box cars lifted from tracks; streets impassable.	Do.

[1] Yards when not otherwise specified. "Mi." signifies miles.

[2] See note for the entry below: "Iowa (parts of): 11."

SEVERE LOCAL HAIL AND WIND STORMS, JUNE, 1925—Continued

Place	Date	Time	Width of path, yard	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Manning, S. C.	9	6 p. m.			$2,000	Wind	A number of buildings damaged; shade trees blown down.	Official, U. S. Weather Bureau.
Lower Peninsula, Mich.	9					do	Great crop damage, principally to onions, peppermint, cabbage, and early corn.	Do.
Ballinger, Tex. (near)	9		6 mi.			Hail	Some property damage, also gardens and crops, including total loss of cotton.	Do.
Athens, Ga.	10	P. m.				Wind	General damage done.	Do.
Santa Rosa, N. Mex., and vicinity.	10	12:30–1:30 p. m.	3,520		5,000	Heavy hail	Character of damage not reported.	Do.
Garden City, Kans.	10	6 p. m.	1–6 mi.		90,000	Severe hail	Extensive damage to growing wheat.	Do.
Dodge City, Kans. (near)	10	10 p. m.			100,000	do	Heavy damage to growing corn and wheat.	Do.
Cochrane, Wis.	11	6 a. m.	1,760		25,000	Moderate to heavy hail.	Much damage to crops over a path 6 miles long.	Do.
Cheyenne County, Kans.	11	4 p. m.	5 mi.		150,000	Hail	One of the most destructive storms in the history of the county. Chief damage to wheat.	Do.
Dundy, Hitchcock, and Red Willow Counties, Nebr.	11	4–7 p. m.	4–10 mi.			do	Crops in path injured 10 to 75 per cent; minor property damage.	Do.
Chapman, Nebr. (near)	11	5.30 p. m.	60–100			Tornado	Some property damage.	Do.
Iowa (parts of)	11				[1]1,050,000	Series of tornadoes, destructive hail, and rain.	Extensive damage to property and crops; many persons injured.	Do.
Eagle Prairie, Wis.	12	2 p. m.			1,000	Thunder squall	Silos and sheds damaged.	Do.
Fortville, Wis.	12		3 mi.		1,500	do	Damage mainly to small farm buildings.	Do.
Blair, Wis.	13	5 p. m.	2,640		10,000	Heavy hail	Severe crop damage.	Do.
Juneau County, Wis. (sw. part of).	13	5.45 p. m.	20		70,000	Small tornado and hail.	Barns and outbuildings razed; several houses partially unroofed; some livestock killed; extensive crop damage.	Do.
Calhoun County, Iowa	13					Hail	Crops damaged about 50 per cent.	Do.
Red Oak, Iowa	14	A. m.				do	Much glass broken and crops injured.	Do.
Polk County, Nebr.	14	7 a. m.	2–3 mi.			do	Damage severe in places; crops more or less damaged, some completely destroyed.	Do.
David City, Nebr.	14	8 a. m.	8–10 mi.			do	Crop damage estimated from 30 to 40 per cent.	Do.
Malvern, Iowa	14	10 a. m.				do	Crops considerably injured.	Do.
Adams County, Iowa	14	11 a. m.	2 mi.		35,000	do	do	Do.
Webster County, Nebr.	14	5 p. m.	2 mi.		25,000	do	Considerable damage in area covered.	Do.
Denver, Colo., and vicinity	14	7 p. m.	1,760		10,000	Heavy hail	Much glass in greenhouses broken; fruit trees stripped in some sections.	Do.
Omaha, Nebr.	14					Hail and wind	Great damage to glass; fruit bruised and knocked off.	Do.
Carthage, Ill. (2 miles north of).	14		100		10,000	Tornadic wind	All buildings on one farm destroyed; crops and timber damaged; 3 persons injured.	Do.
Mason County, Ill. (east part of).	14				20,000	Wind	Damage to farm property over 15-mile path.	Do.
Deaver, Wyo.	15	4:20–4:35 p. m.				Heavy hail	Washed out structures; damaged hay and gardens.	Do.
Greeley, Colo.	15	5–9 p. m.	3,520			Hail and rain	Crops destroyed over path 8 miles long; windows and roofs damaged.	Do.
Fort Lupton, Colo.	15	5–9 p. m.	3,520			do	Considerable crop damage; minor property damage.	Do.
Clay Center, Kans. (near)	15	7:30 p. m.	200		10,000	Tornado	Farm buildings damaged.	Do.
Delphos, Kans.	15	8:30 p. m.	1,760		100,000	do	Residences, outbuildings, water works, light plant, and telephone exchange badly damaged.	Do.
Erie County, Pa. (south part of).	15					Hail	Much crop damage reported.	Do.
New Hartford, Conn., and vicinity.	15					High wind and rain.	Tobacco and orchards damaged; highways blocked; several homes unroofed.	Hartford Courant (Conn.).
Portland, Me.	16	5:45 a. m.				Thunderstorm	Two houses struck by lightning; several telephone lines out of commission; trees torn up.	Official, U. S. Weather Bureau.
Blue Hill, Nebr. (near)	16	5 p. m.				Tornado	Barns and outbuildings on one farm total loss, house damaged.	Do.
Polk County, Nebr.	16	7 p. m.	50		1,000	do	Several barns and sheds wrecked; trees uprooted.	Do.
Prague, Nebr. (2 miles south of).	16	7:30 p. m.	440			do	Country schoolhouse wrecked; buildings on two farms damaged.	Do.
Columbia, Mo.	17	9 p. m.			1,200	Severe electric, wind, and rain.	Minor damage about the city; lowlands flooded, destroying crops.	Do.
Nashville, Tenn.	18				5,000	Thunderstorm	Several buildings damaged.	Do.
Abilene, Tex. (4 miles north of).	18		1,760			Hail	Heavy damage over small area.	Do.
St. Paul, Nebr.	20	3:45–3:55 p. m.	880			do	Gardens and crops injured.	Do.
Orange to Nansemond Counties, Va.	21	P. m.	½–20 mi.			Severe thunderstorm and hail.	Serious loss to crops and considerable damage to buildings. Damage in Richmond estimated at $75,000.	Do.
Chowan, Bertie, Beaufort, Pitt, Green, and Lenoir Counties, N. C.	21				250,000	Hail	Cotton, corn, and tobacco badly damaged.	Do.
Nos Nutrias, N. Mex.	22			1		Severe thunderstorm.	One person killed by lightning; no property damage reported.	Do.
Hawkinsville, Ga.	23					Wind, rain, and hail.	Shade trees, electric light and telephone wires down; several small houses unroofed.	Do.
Dora, N. Mex. (near)	23–24					Wind and rain	Windmills and outbuildings damaged.	Do.
Lexington, Ky. (near)	24	8 p. m.	3,520			Thunderstorm and hail.	Tobacco badly damaged over path 6 miles long.	Do.
Webster County, Nebr.	26	6 p. m.	1–2 mi.		50,000	Hail and wind	Poultry and cattle injured; crops damaged.	Do.
McLean, N. Y., and vicinity.	27	3 p. m.	1,760		3,000–5,000	Moderate hail	Truck gardens damaged.	Do.
Atchison, Nodaway, and Andrew Counties, Mo.	27	8–10:30 p. m.			100,000	Severe hail	Storm very severe in Fillmore, many persons injured; roofs pierced; some hogs killed; windows and autos damaged. Heaviest damage to wheat and oat crops.	Do.
Gage County, Nebr.	27	10 p. m.	3–6 mi.			Hail	Corn stripped; small grains injured and garden truck ruined.	Do.
Fremont County, Iowa (east part of.)	28	2 a. m.			10,000	do	Crops damaged 15 per cent.	Do.
Mills County, Iowa	28	2 a. m.	1,760			do	Crops damaged 5 to 25 per cent.	Do.
Cato, N. Y.	28				5,000	Thunderstorm	Valuable cattle killed by lightning; no other damage reported.	Do.
Esopus, Marlboro, Middlehope, and Cornwall, N. Y.	29	1.30 p. m.	1–8 mi.		200,000–350,000	Heavy hail, rain, and wind.	Heavy damage to apples, pears, cherries, and grapes; soil washed by torrential rains; vineyards damaged by wind.	Do.
Stillwater, Okla.	30	4 p. m.	880		8,000	Wind and hail	Considerable property and crop damage.	Do.

[1] Includes damage done in Iowa on June 1–3.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

The only storm warnings of the month were displayed from Delaware Breakwater to Eastport, Me., at 10 p. m. of the 24th in connection with a disturbance of considerable intensity that moved eastward over the southern Lake region. The highest wind velocities reported were 36 miles an hour from the northeast at Eastport and 48 miles from the northwest at New York City.

Small-craft warnings were displayed from Delaware Breakwater to Boston on the 16th; from Sandy Hook to Eastport on the 18th; and from Delaware Breakwater to Block Island, R. I., on the 25th.

Except for warnings of light frost in the cranberry bogs of New Jersey on the 11th, no frost warnings were issued during the month.—*C. L. Mitchell.*

CHICAGO FORECAST DISTRICT

Storm warnings.—No storms of major character occurred on the Great Lakes during the month, but there were several disturbances of more or less minor force that were attended by winds that just reached or slightly exceeded (for short periods as a rule) the velocities considered as of storm strength. Most of the disturbances referred to affected only the upper Lakes. In the majority of cases the conditions were covered by small-craft warnings, but in a few instances storm warnings were issued.

On the afternoon of the 9th winds of just about verifying force were attained over virtually all the upper Lakes section in connection with a disturbance that had moved from the southeastern slope of the Rocky Mountains to the Red River of the North Valley, whence a path was taken that carried the center north of Lake Superior on the date in question. Southwest storm warnings had been issued on the afternoon of the preceding date for most of the upper Lake districts, but the warnings were taken down the same night when it appeared that the disturbance was losing energy. A redevelopment took place that night, however, and small-craft warnings were advised on the morning of the 9th for the upper Lakes.

On the night of the 11th northeast warnings were issued for Lake Superior, and southeast warnings for Lake Michigan. At that time a trough of low pressure of some depth covered the Plains area, while at the same time a marked high pressure area overlay the Northeast. On the morning of the 12th southwest warnings were issued for Lake Huron. All warnings were justified, since verifying velocities occurred along the west shore of Lake Michigan, and near verifying velocities elsewhere.

The final disturbed period of the month covered the 24–26. On the date first mentioned a moderate barometric depression moved from the Middle West to the lower Lake region, increasing in energy as it progressed; while a second disturbance moved southeastward from the Northwest on the 25th in rapid succession, it likewise increasing in force as it advanced. The wind attained the strength of a moderate storm over most of Lake Superior, but elsewhere no verifying velocities were reached. Messages either of an advisory character or small craft warnings were issued in this connection.

Frost warnings.—A few frost warnings were issued, but these were in most cases for districts of little agricultural importance, and consequently the warnings were of little economic value. The warnings in question were those of the 10th and 27th for northern Michigan; and on the 13th, for northwestern Wyoming; and from the 26th to the 29th, for either all or portions of the Wisconsin cranberry section. Some frost occurred in the bogs on two or three nights within the period mentioned, but no damage resulted.

Fire-weather forecasts.—Those to the State Forester at St. Paul, Minn., were discontinued temporarily, on the 10th, at which time the critical conditions in the Minnesota area had passed. Upon request by the Forester the forecasts will be continued during the next fire period. —*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

The prevailing movement of barometric depressions that formed in the Southwest was toward the extreme north-central portion of the country and no well-defined disturbance passed across the west Gulf district. Conditions were mostly favorable for local showers along the coast and much hot, dry weather in the interior.

No storm warnings were issued or needed. Small-craft warnings were displayed on the east coast of Texas on the 12th and were justified.—*R. A. Dyke.*

DENVER FORECAST DISTRICT

The persistent high barometric pressure that characterized the month in the Eastern and Southern States was accompanied by the development of an unusually large number of low-pressure areas over the western half of the country, especially in Colorado and New Mexico. Only three of these southwestern LOWS attained sufficient energy to pass eastward out of the district, and two of them progressed no farther than the Missouri Valley. The presence of so many LOWS, fluctuating both in intensity and position, was reflected in the remarkably unstable temperature conditions for which the month was notable in this district.

While generally unsettled conditions prevailed, with local showers somewhere in the district nearly every day, the only period of general precipitation was from the 19th to 21st, when showers occurred over most of Colorado, New Mexico, southern Utah, and eastern Arizona.

Because of active LOWS in Arizona or eastern New Mexico, fire-weather warnings for the forests of Arizona, New Mexico, and southern Utah were issued on the 3d, 5th, 6th, and 17th, all of which, except the last, were followed by wind velocities sufficiently high over the regions specified to render the fire hazard very great.—*E. B. Gittings, jr.*

SAN FRANCISCO FORECAST DISTRICT

The weather in this district during the month of June was marked by two entirely different types. During the first part of the month the barometric pressure, with but little interruption, remained low over the North Pacific States and northern Plateau region, while the Pacific Ocean HIGH was central between the California coast and Hawaiian Islands. This distribution of pressure caused generally cloudy and cool weather with frequent rains in the western portions of Washington and Oregon, the northern Plateau region, and the extreme northern portion of California, and cool weather with considerable cloudiness in other portions of the district.

This condition greatly delayed the maturing of both grain and fruit crops in California, and at times caused considerable anxiety concerning the probable yield of each. On the 3d, 4th, and 10th frosts occurred in the northern Plateau region.

During the latter part of the second decade there was a marked change in the pressure distribution. The Pacific Ocean HIGH moved farther north and a portion

moved inland over the North Pacific States, western Canada, and the northern Rocky Mountain region, and covered those sections during the remainder of the month.

This distribution of pressure caused clear and decidedly warmer weather over the entire district with light dry northerly winds and very low humidity, and developed into a "hot wave" of marked intensity, especially over the northern and central portions of this district. Temperatures equal to or exceeding all previous records for June were reported at a number of stations, and the highest temperature ever recorded occurred at North Head, Seattle, Tacoma, Marshfield, and Sacramento. In this connection it is well to note that the record broken at Sacramento covers a period of 47 years. At the breaking of the "hot wave" numerous thunderstorms occurred in the Plateau region, the Sierra Nevada and mountain regions of southern California.

Fire-weather warnings were issued in California on the 13th, and over the entire district on the 23d, and supplementary advices continued daily until the 28th. These warnings were timely and highly appreciated by interested parties.—*G. H. Willson.*

RIVERS AND FLOODS

By H. C. FRANKENFIELD

As will be noted in the table following this report, no floods of consequence—except that continuing in the drainage area of the Columbia River—occurred in the important rivers of the country during June, 1925. The scattered rises in Nebraska, Kansas, Missouri, and Texas were due largely to heavy local rains and were attended by no important loss except that of one highway bridge and 2,000 head of cattle along the Nueces River of Texas; the high stages in the lower Rio Grande occurred as part of the great flood reported upon in the May number of this REVIEW; and the Colorado, while still above flood stage at Parker, Ariz., at the close of the month, had caused no flood damage.

There were, however, as results of so-called cloudbursts, a few destructive floods in scattered smaller streams. Of these the most costly occurred in the Delaware River and Big Stranger and Soldier Creeks of northeastern Kansas, where two boys were drowned, and estimated property losses totaling $1,792,000, exclusive of that to railroads, occurred as follows: Tangible property, $167,000; prospective crops, $1,590,000; livestock and movable property, $20,000; and suspension of business, $15,000.

Of somewhat similar conditions in Iowa the official in charge of the Weather Bureau office at Dubuque reports as follows:

> A series of four heavy rainstorms visited northeastern Iowa from June 11 to 24, resulting in floods which took a toll of 10 lives and cost in damage to property, including livestock, prospective crops, highways and bridges, railway trackage and bridges, and town properties, a total of approximately $1,888,000.

In this case the greatest single item of loss was $490,000 in prospective crops, with damage to highway bridges and fills and to railroads each closely approaching that figure. The major part of the damage occurred along the Maquoketa River, where the three hardest-hit communities—Manchester, Dyersville, and Cascade—suffered losses totaling $450,000.

Another flood of similar character but less destructiveness occurred on the Zumbro River of Minnesota. Newspapers report two casualties in this flood, and losses at from $100,000 to $500,000.

As a result of the rainfall shortage in the upper Mississippi Valley during the spring of 1925, which was in many localities the driest spring of record, the Mississippi River fell lower at virtually every gaging station from the headwaters to St. Louis, Mo., than in any previous May or June of record. Below St. Louis the river was generally lower than in any June since 1895. The following table gives comparative stages for the months of May and June:

Low water in May and June on Mississippi River. Previous records compared with 1925

	Low water record for month of May		Low water record for month of June	
	Previous record	1925 record	Previous record	1925 record
Fort Ripley, Minn	3.4, 1924	3.4	3.3, 1924	3.3
St. Paul, Minn	0.0, 1924	−0.5	−0.4, 1924	−0.6
Red Wing, Minn	0.7, 1911	0.3	0.3, 1910	0.2
Reads, Minn	0.4, 1911	0.6	0.2, 1900 and 1910	0.5
Winona, Minn	3.6, 1921 and 1924	0.8	1.6, 1924	0.8
La Crosse, Wis	1.8, 1879	0.9	1.3, 1910	0.9
Lansing, Iowa	4.7, 1923	2.1	2.9, 1923	2.1
Prairie du Chien, Wis	2.0, 1895	2.0	1.3, 1900	1.8
Dubuque, Iowa	2.0, 1879	2.0	1.4, 1900	1.9
Clinton, Iowa	2.9, 1911	2.5	2.1, 1910	2.4
Le Claire, Iowa	1.2, 1895 and 1902	1.3	0.7, 1900	1.2
Davenport, Iowa	1.4, 1895	1.3	1.4, 1900	1.2
Muscatine, Iowa	1.3, 1895	1.9	2.1, 1910	1.9
Keokuk, Iowa	1.0, 1902	0.3	1.1, 1900	0.3
Warsaw, Ill	2.8, 1895	2.5	3.5, 1887	2.6
Quincy, Ill	3.0, 1911	1.1	2.6, 1910	1.2
Hannibal, Mo	2.1, 1902	1.6	2.4, 1895 and 1900	1.5
Louisiana, Mo	2.1, 1895	1.8	2.2, 1895	1.6
Grafton, Ill	3.9, 1895	4.1	3.7, 1895	3.7
Alton, Ill	7.8, 1918	4.9	8.7, 1891 and 1923	5.0
St. Louis, Mo	5.6, 1895 and 1911	5.6	7.1, 1895	6.0
Chester, Ill	3.2, 1895	6.4	4.4, 1895	6.5
Cape Girardeau, Mo	9.4, 1911	9.6	9.8, 1911	9.5
Cairo, Ill	13.6, 1895 and 1911	14.2	9.8, 1895	12.8
New Madrid, Mo	11.9, 1911	9.8	10.0, 1911	8.0
Memphis, Tenn	7.0, 1895	10.2	4.4, 1895	6.6
Helena, Ark	11.0, 1895	14.1	8.1, 1895	8.4
Arkansas City, Ark	12.4, 1895	18.6	8.0, 1895	9.4
Greenville, Miss	9.8, 1895	13.1	7.3, 1895	7.0
Vicksburg, Miss	10.2, 1895	17.3	6.7, 1895	10.6
Natchez, Miss	21.0, 1915	16.9	10.2, 1911	10.1
Baton Rouge, La	17.2, 1915	8.8	5.5, 1911	4.8
Donaldsonville, La	12.5, 1915	6.0	3.6, 1911	3.5
New Orleans, La	1.2, 1895	2.3	1.0, 1895	1.5

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI DRAINAGE	*Feet*			*Feet*	
Sulphur: Ringo Crossing, Tex	20	9	11	25.0	9
Kansas: Bonner Springs, Kans	18	19	21	18.3	19
Big Blue:					
Beatrice, Nebr	16	17	17	16.9	17
Blue Rapids, Kans	20	18	18	20.6	18
Grand:					
Gallatin, Mo	20	4	5	29.8	4
Chillicothe, Mo	18	4	6	24.1	6
		17	17	18.3	17
Brunswick, Mo	10	5	8	11.9	7
		14	22	12.4	19
		29	30	10.4	30
WEST GULF DRAINAGE					
Nueces: Cotulla, Tex	15	3	7	18.0	5
Rio Grande:					
Rio Grande City, Tex	15	(1)	3	24.5	2
Mission, Tex	24	3	5	24.5	3
San Benito, Tex	21	1	6	24.4	5
COLORADO DRAINAGE					
Colorado:					
Lees Ferry, Ariz	12	(1)	10	13.5	3
		20	30	13.4	25
Parker, Ariz	7	(1)	14	8.2	May 31
		24	(2)	7.6	June 28–30
PACIFIC DRAINAGE					
Columbia:					
Marcus, Wash	24	(1)	(2)	30.4	May 26
Wenatchee, Wash	40	(1)	(3)	40.8	May 28
Vancouver, Wash	15	(1)	17	21.5	May 25–26
		22	30	15.6	June 25–26
Pend Oreille: Newport, Wash	16	(1)	14	19.9	May 31 to June 2
Willamette: Portland, Oreg	15	(1)	(2)	21.7	May 26

[1] Continued from last month.
[2] Continued at end of month.
[3] Below flood stage at 8 a. m., June 1, 1925.

MEAN LAKE LEVELS DURING JUNE, 1925

By UNITED STATES LAKE SURVEY

[Detroit, Mich., July 6, 1925]

The following data are reported in the Notice to Mariners of the above date:

Data	Lakes[1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during June, 1925:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	601.22	578.44	571.19	245.42
Above or below—				
Mean stage of May, 1925	+0.28	+0.02	−0.11	−0.23
Mean stage of June, 1924	−0.01	−0.96	−1.11	−0.85
Average stage for June last 10 years	−1.02	−2.26	−1.57	−1.18
Highest recorded June stage	−2.21	−5.16	−3.33	−3.21
Lowest recorded June stage	−0.01	−0.96	−0.38	+0.53
Average relation of the June level to—				
May level		+0.2	+0.2	+0.2
July level		−0.1	[2]	[2]

[1] Lake St. Clair's level: In June, 1925, 573.73 feet.
[2] Practically no difference.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, JUNE, 1925

By J. B. KINCER

General summary.—Following the brief cool spell the latter part of May which caused considerable damage to tender vegetation and some harm to staple crops in Central and Northern States, the warm weather that prevailed during the first part of June promoted rapid recovery from the effect of the cold wherever moisture was sufficient. It had become too dry, however, over most of the central and eastern parts of the country, which retarded considerably the development of some crops, particularly grass and small grains. Conditions continued unusually favorable for farming and grazing interests in the northwestern portions of the country.

The timely rains about the middle of the month largely relieved the drought in most of the central valley States and were very beneficial, especially to late small grains, corn, potatoes, pastures, and meadows. Later the drought was partly relieved also in the more eastern States, and at the close of June soil moisture conditions were mostly favorable north of the Cotton Belt. In the South rainfall throughout the month was generally of a local character and temperatures were favorable where moisture was sufficient. In the dry areas most vegetation made slow growth and in some cases crops deteriorated, especially in the west Gulf section. There was urgent need for rain also over most of the southwestern range country.

Small grains.—The warm weather early in the month ripened winter wheat rapidly, prematurely in some sections, and harvest began early in many districts. At the close of June the cutting of wheat had begun as far north as Pennsylvania, northern Indiana, and eastern Nebraska, and threshing was progressing in the southwestern portion of the Wheat Belt. The rains came too late to benefit winter wheat in much of the principal producing area, although some improvement was noted in the northern portions of the belt. Spring wheat continued to grow well in nearly all parts of the Spring Wheat Belt. There were only local complaints of dryness and temperatures were favorable, except for the hot weather in the Pacific Northwest near the close of the month. The crop was heading on rather short straw in parts of the Dakotas and there was locally too much rain in Minnesota, but in general the condition of spring wheat was good to excellent at the close of June. Oats were benefited by the rains, but they headed short nearly everywhere, because of previous dry weather, making harvest difficult in some sections. There was some increase in the length of the straw after the rain, and the heads filled better.

Corn.—With good growing conditions corn recovered nicely from the effect of the May freeze and thereafter made rapid growth. The rains in the Corn Belt were timely and very beneficial, and cultivation of the crop was very good, though there was local complaint of weedy fields where rains had been frequent. In contrast to last year, corn at the close of June was well advanced for the season, being reported a week ahead of the average in some sections, with much laid by as far north as Iowa. In the South conditions were less favorable for this crop, as general and substantial rains were badly needed in many localities.

Cotton.—Cotton made irregular progress because of the local character of the rainfall. Temperatures were generally favorable, and wherever moisture was sufficient the plants made good to excellent growth, but many localities were too dry in the central and eastern portions of the belt, and drought was more extensive and was severe throughout central and southern Texas. Cotton in most sections withstood the drought very well, however, and growth was generally fair to very good, except in the more pronouncedly droughty sections of Texas where it was poor with deterioration reported. The weather was favorable for cultivation and also for holding the weevil in check. While considerable weevil activity was reported, no damage of consequence was noted, except for a moderate amount of harm in extreme southern Texas.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation, by sections, June, 1925

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	81.1	+2.9	Troy	104	22	2 stations	55	[2]1	2.26	−2.06	Mobile	7.19	Tuscaloosa	0.54
Alaska [*May*]	45.0	+1.6	Fortmann Hatchery	82	[2]16	2 stations	0	[2]3	3.30	+0.06	Latouche	17.68	Fairbanks (near)	0.02
Arizona	74.2	−1.5	Quartzsite	117	24	Spring Valley	22	[2]5	1.14	+0.83	Bisbee	6.34	2 stations	0.00
Arkansas	82.3	+5.5	Helena	108	20	2 stations	46	[2]2	2.08	−2.00	Grannis	6.66	Springbank	0.12
California	68.4	+1.0	Greenland Ranch	123	27	Tamarack	15	4	0.58	+0.27	Julian	3.66	27 stations	0.00
Colorado	61.8	+0.9	Holly	105	4	2 stations	22	[2]8	1.74	+0.31	Silverton	5.48	Rifle	0.06
Florida	79.9	+0.2	2 stations	100	[2]21	3 stations	57	3	6.07	−0.38	Punta Gorda	12.70	Key West	0.53
Georgia	80.7	+2.5	4 stations	105	22	Blue Ridge	49	27	2.88	−1.75	Saint George	9.07	Canton	0.25
Hawaii	72.6	−0.1	Pahala	96	29	Volcano Observatory.	51	25	5.60	+0.09	Pun Kukui (upper)	39.00	5 stations	0.00
Idaho	60.9	+0.3	Chattin Flat	113	25	3 stations	21	[2]4	1.71	+0.38	Pete King Ranger Station.	3.83	Parma	0.31
Illinois	74.7	+3.2	2 stations	102	[2]5	Waukegan	40	28	5.04	+1.19	Paris	10.43	Galva	2.19
Indiana	74.6	+3.2	Monticello	110	6	Hobart	37	9	3.81	−0.03	Frankfort	9.39	Columbia City	1.62
Iowa	70.4	+1.1	4 stations	98	20	Milford	38	9	6.64	+2.11	Oelwein	13.30	Marshalltown	2.99
Kansas	77.6	+4.5	Hutchinson	110	30	2 stations	42	[2]8	4.03	+0.05	Horton	14.91	Dresden	0.20
Kentucky	77.0	+3.1	Greenville	105	4	Farmers	48	11	3.90	−0.19	Munfordville	7.58	Wayland	1.67
Louisiana	81.5	+1.5	2 stations	104	[2]15	Delta Farms	59	1	4.19	−0.68	Delta Farms	13.18	Grand Cane	0.59
Maryland-Delaware	75.6	+4.8	3 stations	104	5	Oakland, Md	36	1	2.30	−1.69	Cumberland, Md	8.27	Public Landing, Md.	0.39
Michigan	66.3	+2.9	Mount Clemens	104	5	Onaway	26	28	2.41	−0.67	Sack Bay	5.61	Grand Ledge	0.62
Minnesota	63.5	−1.0	New London	98	6	Pine River Dam	24	30	6.91	+2.82	New Ulm	11.15	Duluth	3.20
Mississippi	81.5	+2.0	Columbus	104	[2]22	University	55	26	2.48	−1.78	Poplarville	5.89	Anguilla	0.32
Missouri	76.5	+3.0	Caruthersville	103	[2]22	Goodland	46	27	6.10	+1.43	St. Joseph	12.55	Caruthersville	0.27
Montana	60.3	+0.4	Libby	101	26	Adel	26	[2]4	2.83	+0.23	Glendive	6.99	Libby	0.69
Nebraska	70.9	+1.6	3 stations	105	[2]14	Fort Robinson	34	8	4.46	+0.66	Butte	8.65	Beaver City	1.13
Nevada	64.6	−0.4	Logandale	112	[2]24	Millett	22	5	1.17	+0.67	Lamoille	4.42	Goldfield	0.07
New England	66.3	+3.0	Waterbury, Conn	101	6	Pittsburgh, N. H	29	24	4.09	+0.71	Greenville, Me	6.91	Bristol, R. I	1.48
New Jersey	73.6	+5.1	Belvidere	103	5	Charlotteburg	36	[2]12	3.10	−0.64	Chatham	6.16	Trenton	0.72
New Mexico	69.7	+1.1	Animas	107	12	2 stations	24	8	0.98	−0.45	Texico (near)	3.86	3 stations	0.00
New York	68.1	+3.3	Ohioville	103	7	Indian Lake	29	23	4.18	+0.59	Salisbury	8.00	Silver Bay	0.91
North Carolina	76.7	+3.1	5 stations	100	[2]3	Parker	42	1	3.91	−0.99	Greenville	10.43	Graham	0.42
North Dakota	61.5	−1.3	New Salem	98	21	Hansboro	30	27	6.07	+2.57	Fullerton	12.97	New England	3.37
Ohio	73.0	+3.6	4 stations	102	[2]5	3 stations	37	11	2.85	−0.98	Piqua	6.34	Madison	1.11
Oklahoma	82.5	+6.2	Marlow	109	29	2 stations	49	[2]8	2.13	−1.94	Smithville	7.68	2 stations	T.
Oregon	61.6	+1.3	3 stations	110	[2]24	Fremont	22	[2]3	1.09	−0.27	Classic Lake	4.18	Grants Pass	0.00
Pennsylvania	71.9	+4.1	2 stations	104	[2]5	West Bingham	29	24	3.04	−1.19	Mount Pocono	7.02	2 stations	0.62
Porto Rico	78.1	−0.3	2 stations	96	[2]11	Toro Negro Reservoir.	59	[2]7	5.85	−0.66	Maricao	21.50	Potala	0.08
South Carolina	80.4	+2.8	2 stations	105	22	3 stations	58	[2]1	3.09	−1.71	Darlington	7.93	Calhoun Falls	T.
South Dakota	65.5	−0.7	Hot Springs	102	30	Milbank	30	10	5.66	+2.22	Faulkton	11.22	Vale	2.21
Tennessee	78.5	+4.1	Etowah	104	18	Crossville	47	27	2.72	−1.54	Elizabethton	6.95	2 stations	0.35
Texas	83.4	+3.3	2 stations	110	[2]12	Clint	40	7	1.41	−1.86	Galveston	12.95	4 stations	0.00
Utah	61.7	−2.6	St. George	106	26	Woodruff	20	6	1.98	+1.38	Parawan	4.33	Hanksville	0.17
Virginia	75.8	+4.2	Danville	103	4	Fredericksburg	40	12	2.77	−1.79	Mendota	5.86	Danville	0.40
Washington	62.3	+1.4	Wahluke	110	26	Republic	25	3	0.91	−0.50	Quinault	3.59	Cowiche	0.03
West Virginia	72.2	+3.1	Burlington	109	3	Terra Alta	35	[2]14	3.51	−0.51	Bayard	8.06	Upper Tract	1.05
Wisconsin	65.7	+1.3	2 stations	96	[2]2	Long Lake	27	29	6.07	+2.12	Mondovi	11.08	Cornucopia	2.20
Wyoming	58.0	−1.0	Basin	99	20	Dubois	18	3	2.41	+0.87	Kirtley	5.94	Lander	0.48

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Hawaii [*March*]	69.4	+0.9	3 stations	87	[2]1	Waimea	47	7	12.03	+3.11	Waiakamoi Gulch	70.25	Mahukona	0.79

[1] For description of tables and charts, see REVIEW, January, 1925, p. 42.

[2] Other dates also.

TABLE 1.—*Climatological Data for Weather Bureau Stations, June, 1925*

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
New England							**66.5**	**+2.9**										**76**	**3.43**	**+0.3**										**5.2**		
Eastport	76	67	85	29.82	29.90	-.03	56.2	+1.1	87	4	65	44	7	47	41	53	51	86	2.87	-0.4	18	5,522	s.	37	ne.	25	1	10	19	7.9	0.0	0.0
Greenville, Me	1,070	6	----	28.77	29.91	-----	59.6	-----	82	4	70	38	20	49	36	----	----	----	6.91	-----	22	-----	se.	----	----	----	4	12	14	----	0.0	0.0
Portland, Me	103	82	117	29.82	29.94	-.01	64.4	+1.9	95	6	74	50	9	55	31	58	53	72	3.51	+0.2	15	6,168	s.	43	nw.	16	9	11	10	5.6	0.0	0.0
Concord	288	70	79	29.62	29.92	-.04	67.0	+4.1	96	6	79	42	24	54	39	----	----	----	2.61	-0.7	14	2,049	nw.	10	nw.	16	19	8	3	3.1	0.0	0.0
Burlington	404	11	48	29.48	29.91	-.05	66.0	+0.3	94	6	75	41	24	57	29	----	----	----	4.27	+1.0	17	7,049	s.	48	sw.	13	3	17	10	6.6	0.0	0.0
Northfield	876	12	60	29.00	29.93	-.03	63.5	+2.2	92	6	75	36	24	52	36	58	55	73	3.81	+0.6	15	5,130	s.	31	sw.	10	3	18	9	6.4	0.0	0.0
Boston	125	115	188	29.81	29.94	-.02	70.9	+4.4	100	6	81	53	8	61	39	63	58	69	4.59	+1.6	12	7,050	w.	40	w.	16	10	17	3	4.8	0.0	0.0
Nantucket	12	14	90	29.94	29.95	-.03	64.4	+3.4	87	6	72	51	8	57	30	61	59	86	4.06	+1.6	15	10,885	sw.	36	sw.	28	7	13	10	6.0	0.0	0.0
Block Island	26	11	46	29.93	29.96	-.01	66.1	+4.3	86	6	72	54	17	60	29	61	59	83	3.50	+0.6	13	11,071	sw.	46	nw.	16	11	11	8	4.7	0.0	0.0
Providence	160	215	251	29.79	29.96	-.01	70.3	+2.0	96	4	81	53	8	60	42	62	56	66	1.73	-1.4	10	7,667	w.	50	nw.	16	12	13	5	4.5	0.0	0.0
Hartford	159	122	140	29.79	29.96	-.01	71.4	+4.3	97	4	82	52	12	61	38	----	----	----	3.38	+0.3	12	-----	s.	----	----	----	17	9	4	3.5	0.0	0.0
New Haven	106	74	153	29.85	29.96	-.01	71.0	+4.4	98	6	80	52	13	62	32	63	58	70	3.35	+0.2	15	5,971	s.	36	nw.	21	15	12	3	4.0	0.0	0.0
Middle Atlantic States							**74.6**	**+4.4**										**70**	**2.53**	**-1.1**										**4.8**		
Albany	97	102	115	29.84	29.94	-.03	71.0	+3.0	97	3	82	49	24	60	32	63	58	68	2.89	-0.9	16	5,205	s.	36	ne.	1	16	10	4	3.8	0.0	0.0
Binghamton	871	10	84	29.04	29.95	-.02	70.0	+4.4	97	5	82	41	24	58	39	----	----	----	3.10	-0.5	13	4,107	nw.	21	nw.	18	8	16	6	5.2	0.0	0.0
New York	314	414	454	29.64	29.97	-.01	73.2	+4.4	96	6	82	53	11	65	34	64	59	67	2.31	-1.0	9	11,651	nw.	64	nw.	16	5	19	6	5.6	0.0	0.0
Harrisburg	374	94	104	29.60	29.99	.00	75.2	+4.9	99	6	86	52	12	64	30	64	58	60	5.01	+1.5	9	4,807	nw.	35	sw.	28	8	15	7	5.6	0.0	0.0
Philadelphia	114	123	190	29.86	29.98	.00	78.0	+6.6	100	5	88	56	11	68	28	68	64	66	1.16	-2.1	8	6,173	sw.	27	nw.	16	12	13	5	4.5	0.0	0.0
Reading	325	81	98	29.64	29.98	-----	76.0	-----	101	6	87	53	12	65	31	67	61	67	2.60	-1.1	12	4,420	nw.	25	se.	25	17	9	4	3.7	0.0	0.0
Scranton	805	111	119	29.13	29.98	.00	71.2	+3.4	97	5	83	46	24	59	34	67	65	82	3.57	0.0	15	4,856	sw.	37	sw.	1	5	20	5	5.2	0.0	0.0
Atlantic City	52	37	172	29.93	29.98	.00	72.4	+5.8	95	6	79	57	12	66	26	66	63	76	2.90	-0.1	8	12,495	sw.	39	nw.	16	17	8	5	3.9	0.0	0.0
Cape May	17	13	49	29.99	30.01	+.03	73.2	+5.5	97	6	81	55	12	65	27	66	63	77	2.47	-0.6	7	4,968	s.	18	s.	29	10	11	9	5.3	0.0	0.0
Sandy Hook	22	10	55	29.94	29.96	-----	72.5	-----	96	5	81	56	11	64	33	65	62	75	3.41	-----	10	9,311	s.	66	nw.	29	9	16	5	4.7	0.0	0.0
Trenton	190	159	183	29.77	29.97	-----	75.2	-----	99	7	86	52	13	64	28	67	63	68	0.72	-2.8	9	7,117	sw.	34	sw.	10	5	17	8	5.8	0.0	0.0
Baltimore	123	100	113	29.85	29.97	-.02	78.7	+6.0	101	5	88	56	11	69	29	68	63	61	1.01	-2.8	7	4,309	sw.	22	ne.	9	12	13	5	4.9	0.0	0.0
Washington	112	62	85	29.87	29.98	-.02	77.4	+5.2	100	5	89	52	12	66	35	67	62	64	1.53	-2.6	10	3,910	sw.	28	nw.	29	11	13	6	4.8	0.0	0.0
Cape Henry	18	8	54	29.99	30.01	-----	77.6	-----	96	18	86	63	12	70	26	70	67	76	3.37	-1.0	11	7,626	sw.	41	w.	18	10	13	7	5.1	0.0	0.0
Lynchburg	681	153	188	29.28	30.01	.00	77.5	+2.9	99	5	89	53	12	66	36	68	64	68	2.77	-1.1	11	4,495	w.	34	n.	17	11	16	3	4.4	0.0	0.0
Norfolk	91	170	205	29.93	30.02	+.02	77.8	+3.4	95	5	87	60	12	69	27	69	66	73	2.60	-1.7	11	8,713	sw.	76	w.	18	7	12	11	5.7	0.0	0.0
Richmond	144	11	52	29.86	30.01	.00	77.9	+3.8	97	5	88	53	12	67	32	69	65	71	2.24	-1.3	11	5,220	sw.	40	nw.	21	14	13	3	3.7	0.0	0.0
Wytheville	2,304	49	55	27.72	30.01	.00	71.0	+2.3	90	5	83	52	12	59	34	63	59	70	2.78	-1.3	10	3,490	w.	23	sw.	25	9	15	6	5.0	0.0	0.0
South Atlantic States							**79.0**	**+2.5**										**74**	**3.20**	**-1.7**										**5.6**		
Asheville	2,255	70	84	27.76	30.03	+.02	72.8	+4.1	88	1	83	56	27	62	29	64	60	70	1.97	-2.2	10	3,948	se.	25	n.	29	11	15	4	4.6	0.0	0.0
Charlotte	779	55	62	29.22	30.03	+.02	80.4	+4.9	97	21	91	63	12	70	27	69	64	64	1.61	-2.8	9	2,675	sw.	17	n.	16	7	11	12	5.8	0.0	0.0
Hatteras	11	11	50	30.03	30.04	+.03	76.9	+1.3	87	21	82	66	23	71	20	73	71	86	7.48	+3.2	11	9,036	sw.	38	w.	18	10	7	13	5.8	0.0	0.0
Raleigh	376	103	110	29.64	30.02	+.01	78.6	+2.9	96	18	89	55	12	68	27	69	65	71	2.60	-2.1	10	5,306	sw.	27	w.	18	10	6	14	5.6	0.0	0.0
Wilmington	78	81	91	29.98	30.06	+.05	78.3	+1.5	96	21	86	61	12	71	23	72	70	81	3.10	-2.5	10	5,171	sw.	26	sw.	25	8	13	9	5.5	0.0	0.0
Charleston	48	11	92	30.01	30.06	+.05	79.8	+0.9	97	19	86	70	4	74	22	75	73	83	5.49	+0.1	12	7,284	sw.	33	e.	12	7	11	12	6.1	0.0	0.0
Columbia, S. C	351	41	57	29.67	30.04	+.03	81.2	+3.1	100	21	92	64	4	71	27	71	67	69	0.72	-3.5	6	4,582	s.	27	sw.	25	7	14	9	5.6	0.0	0.0
Due West	711	10	55	29.31	30.06	-----	80.6	-----	98	21	92	63	4	69	28	----	----	----	1.73	-----	7	5,398	s.	40	n.	9	4	20	6	5.3	0.0	0.0
Greenville, S. C	1,039	113	122	28.95	30.02	-----	79.6	+5.5	96	22	90	65	5	69	27	68	63	62	1.12	-----	6	4,854	e.	35	n.	9	7	20	3	4.9	0.0	0.0
Augusta	182	62	77	29.84	30.03	+.02	81.6	+2.9	101	21	92	65	4	71	29	72	68	69	0.80	-3.7	7	3,638	s.	42	nw.	19	8	14	8	5.6	0.0	0.0
Savannah	65	150	194	29.98	30.05	+.04	79.9	+0.9	99	22	88	66	11	72	23	73	72	83	2.53	-3.5	15	7,526	sw.	40	nw.	23	5	16	9	5.6	0.0	0.0
Jacksonville	43	209	245	30.00	30.06	+.05	79.4	-0.5	94	22	86	68	27	72	19	73	71	80	5.65	+0.1	15	7,751	sw.	40	sw.	20	3	16	11	6.5	0.0	0.0
Florida Peninsula							**81.1**	**+0.2**										**77**	**4.54**	**-2.0**										**5.9**		
Key West	22	10	64	29.99	30.01	+.02	82.7	+0.8	90	21	87	74	4	78	13	75	73	75	0.53	-3.7	10	6,819	se.	23	se.	4	5	16	9	5.7	0.0	0.0
Miami	25	71	79	30.02	30.05	-----	80.0	-0.4	87	26	84	71	6	76	13	74	72	76	5.70	-1.4	12	5,592	se.	30	s.	15	8	12	10	5.9	0.0	0.0
Tampa	35	79	87	30.01	30.04	+.03	80.5	+0.3	91	30	88	68	3	73	21	73	71	79	7.38	-1.0	15	3,825	e.	32	e.	4	3	15	12	6.8	0.0	0.0
Titusville	44	5	----	30.00	30.05	-----	79.7	-----	98	19	87	66	7	72	24	----	----	----	3.76	-----	13	-----	s.	----	----	----	12	3	15	5.3	0.0	0.0
East Gulf States							**80.8**	**+2.2**										**73**	**3.00**	**-1.6**										**5.4**		
Atlanta	1,174	190	216	28.83	30.04	+.03	80.0	+4.0	97	22	90	66	8	70	25	68	63	61	1.45	-2.4	5	6,502	w.	48	nw.	8	8	14	8	5.5	0.0	0.0
Macon	370	78	87	29.64	30.03	+.02	80.8	+1.9	101	22	92	65	5	70	30	70	66	69	2.71	-0.9	11	3,830	s.	37	nw.	30	9	10	11	5.4	0.0	0.0
Thomasville	273	49	58	29.75	30.04	+.04	80.2	+0.7	100	21	90	66	5	70	27	72	70	78	4.71	0.0	17	2,973	sw.	22	sw.	7	2	14	14	7.0	0.0	0.0
Apalachicola	36	42	49	30.00	30.04	-----	79.2	-----	88	24	85	70	12	74	17	74	72	80	4.43	-----	16	5,363	se.	26	se.	12	10	16	4	4.8	0.0	0.0
Pensacola	56	149	185	29.98	30.04	+.05	79.0	-0.3	90	22	84	67	27	74	19	74	73	82	3.35	-1.5	10	8,047	s.	36	nw.	25	5	15	10	6.0	0.0	0.0
Anniston	741	9	57	29.29	30.07	+.07	80.4	+5.4	100	22	93	61	27	68	35	----	----	----	0.87	-3.0	5	2,921	s.	21	se.	11	12	18	0	3.7	0.0	0.0
Birmingham	700	11	48	29.29	30.04	+.05	81.6	+3.7	99	22	93	65	27	70	30	69	64	63	2.24	-1.6	7	4,130	s.	28	n.	30	11	13	6	4.7	0.0	0.0
Mobile	57	125	161	29.97	30.03	+.04	80.8	+0.5	96	21	88	68	12	73	22	74	72	80	7.19	+1.2	14	6,044	sw.	42	nw.	25	3	23	4	5.5	0.0	0.0
Montgomery	223	100	112	29.79	30.03	+.03	82.0	+2.4	99	22	92	66	12	72	29	71	67	66	2.65	-1.6	8	4,209	w.	39	ne.	30	9	15	6	5.1	0.0	0.0
Corinth	469	6	----	-----	-----	-----	81.9	-----	100	21	94	60	27	70	33	----	----	----	0.82	-----	8	-----	s.	----	----	----	6	23	1	----	0.0	0.0
Meridian	375	85	93	29.62	30.00	+.02	80.5	+2.4	98	22	90	66	6	71	28	72	68	71	1.11	-3.5	7	3,398	sw.	22	e.	12	12	13	5	5.0	0.0	0.0
Vicksburg	247	65	73	29.75	30.02	+.05	81.6	+2.6	97	30	91	69	1	72	24	72	68	71	2.57	-1.9	8	4,043	se.	22	se.	30	9	12	9	5.6	0.0	0.0
New Orleans	53	76	84	29.96	30.01	+.03	81.4	+0.8	93	27	89	71	1	74	20	75	73	80	4.12	-2.0	13	4,171	se.	22	ne.	15	3	16	11	6.1	0.0	0.0
West Gulf States							**83.0**	**+3.3**										**69**	**2.52**	**-1.1**										**4.2**		
Shreveport	249	77	93	29.70	29.96	.00	84.2	+3.5	101	21	95	68	26	73	29	72	67	63	1.24	-2.3	7	4,489	se.	35	ne.	30	19	10	1	3.3	0.0	0.0
Bentonville	1,303	11	44	-----	-----	-----	78.8	+4.7	97	28	90	57	26	68	33	----	----	----	3.17	-----	5	4,013	s.	23	s.	2	21	9	0	----	0.0	0.0
Fort Smith	457	79	94	29.44	29.91	-.03	83.6	+6.1	103	28	94	62	26	73	32	72	67	62	1.74	-2.3	7	5,453	e.	26	sw.	7	11	16	3	4.5	0.0	0.0
Little Rock	357	136	144	29.58	29.95	-.01	82.9	+5.5	100	28	93	63	10	72	30	71	65	60	2.51	-1.6	5	6,097	s.	39	n.	10	15	13	2	3.6	0.0	0.0
Brownsville	57	53	61	29.83	29.89	-----	82.2	-0.2	92	11	89	71	1	75	17	75	73	81	2.59	-----	17	5,365	se.	22	sw.	18	9	15	6	4.8	0.0	0.0
Corpus Christi	20	11	73	29.92	29.94	+.03	82.2	+1.2	91	12	87	74	26	77	15	76	74	80	2.70	0.0	4	10,040	se.	36	se.	2	13	13	4	4.3	0.0	0.0
Dallas	512	109	117	29.39	29.92	-----	85.3	-----	102	28	96	68	26	75	29	----	----	----	3.92	-----	6	6,565	s.	35	e.	30	16	12	2	3.3	0.0	0.0
Fort Worth	670	106	114	29.17	29.86	-.06	85.3	+5.4	100	20	95	67	26	76	27	71	64	55	0.29	-2.7	3	8,041	s.	35	ne.	30	10	19	1	4.3	0.0	0.0
Galveston	54	106	114	29.92	29.98	+.03	80.8	+0.1	89	20	84	72	17	77	12	76	74	82	12.95	+8.2	7	8,832	s.	47	ne.	9	12	15	3	4.1	0.0	0.0
Groesbeck	461	11	56	29.45	29.91	-----	85.3	-----	102	20	97	67	30	73	34	----	----	----	1.67	-----	4	8,493	s.	34	e.	18	10	20	0	4.0	0.0	0.0
Houston	138	111	121	29.82	29.96	-----	82.4	+1.0	96	20	91	70	11	74	21	----	----	----	3.01	-----	8	5,576	se.	30	se.	11	13	15	2	4.3	0.0	0.0
Palestine	510	64	72	29.42	29.93	-.01	83.9	+4.9	100	20	75	67	30	73	31	71	66	62	0.68	-3.3	3	6,108	s.	26	s.	2	5	24	1	5.0	0.0	0.0
Port Arthur	34	58	66	29.93	29.97	-----	81.2	-----	92	25	87	70	20	76	21	75	73	80	3.72	-----	13	7,074	se.	31	ne.	30	13	12	5	4.7	0.0	0.0
San Antonio	693	119	132	29.20	29.91	+.01	84.6	+3.6	99	16	95	68	1	74	26	72	67	63	0.48	-2.6	5	6,221	se.	30	se.	8	11	17	2	3.9	0.0	0.0
Taylor	583	55	63	29.36	29.97	+.05	85.3	+4.3	101	20	96	70	5	74	26	----	----	----	0.13	-3.4	3	8,075	se.	34	se.	8	10	20	0	4.2	0.0	0.0

TABLE 1.—*Climatological Data for Weather Bureau Stations, June, 1925*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Ohio Valley and Tennessee							**76.4**	**+3.7**										**64**	**3.00**	**−1.2**										**5.1**		
Chattanooga	762	189	213	29.22	30.01	+.01	79.6	+4.2	97	17	90	61	27	69	28	68	62	58	2.37	−1.9	10	4,499	nw.	42	sw.	9	8	19	3	4.8	0.0	0.0
Knoxville	996	102	111	28.99	30.02	+.02	78.4	+4.4	95	3	89	61	27	67	28	68	63	65	1.78	−2.4	10	3,703	sw.	23	nw.	18	10	17	3	4.5	0.0	0.0
Memphis	399	76	97	29.56	29.98	+.01	83.2	+5.6	98	28	92	66	26	74	24	72	67	62	0.40	−4.0	3	4,877	sw.	36	w.	22	12	14	4	4.3	0.0	0.0
Nashville	546	168	191	29.45	30.02	+.03	79.4	+3.8	97	22	90	60	27	69	29	69	64	62	2.18	−2.2	7	5,438	s.	35	s.	12	12	12	6	4.5	0.0	0.0
Lexington	989	193	230	28.98	30.02	+.02	75.8	+3.6	97	4	85	56	11	67	30				3.96	0.0	8	8,532	sw.	39	n.	6	15	8	7	3.8	0.0	0.0
Louisville	525	188	234	29.44	30.01	+.03	77.4	+2.7	96	4	87	57	11	68	27	67	62	63	2.10	−2.1	7	6,650	s.	48	nw.	29	9	16	5	4.9	0.0	0.0
Evansville	431	139	175	29.54	30.00	+.03	79.2	+4.1	97	5	89	60	30	69	29	68	63	62	5.66	+1.5	7	7,020	sw.	44	w.	22	7	20	3	5.2	0.0	0.0
Indianapolis	822	194	230	29.12	29.98	+.01	74.4	+2.8	98	5	84	52	11	65	31	65	60	65	4.70	+0.4	13	8,086	sw.	44	w.	18	9	13	8	5.6	0.0	0.0
Royal Center	736	11	55	29.18	29.97		71.8		97	5	84	43	30	60	35				2.26		7	7,189	s.	44	w.	15	4	14	12	6.4	0.0	0.0
Terre Haute	575	96	129	29.36	29.97		75.4		98	6	85	53	11	66	33	66	61	65	5.82		14	6,795	s.	36	w.	15	3	17	10	5.8	0.0	0.0
Cincinnati	627	11	51	29.33	30.00	+.01	76.1	+4.9	97	5	86	53	11	66	32		61	62	1.89	−2.1	10	4,615	sw.	28	nw.	15	11	9	10	5.0	0.0	0.0
Columbus	822	179	222	29.14	30.00	+.01	74.6	+3.7	95	5	84	49	11	65	31	65	60	65	1.67	−1.8	8	7,215	s.	41	nw.	22	11	11	8	5.0	0.0	0.0
Dayton	899	137	173	29.04	29.98		74.6	+3.2	98	5	84	51	11	65	31	65	60	64	3.56	−0.4	11	6,369	sw.	37	nw.	26	12	12	6	4.8	0.0	0.0
Elkins	1,947	59	67	28.04	30.02	+.02	68.8	+1.9	92	5	81	45	1	57	41	62	59	75	6.11	+1.1	11	3,151	w.	25	nw.	16	7	14	9	5.7	0.0	0.0
Parkersburg	638	77	84	29.38	30.03	+.03	75.3	+3.9	98	5	86	51	11	65	37	66	62	70	3.48	−1.2	12	3,402	se.	26	nw.	17	15	7	8	4.5	0.0	0.0
Pittsburgh	842	353	410	29.11	29.99	.00	73.1	+2.4	95	5	83	45	11	64	30	64	58	62	2.11	−1.8	11	6,960	sw.	35	nw.	6	5	15	10	6.2	0.0	0.0
Lower Lake Region							**69.5**	**+2.7**										**66**	**2.87**	**−0.7**										**4.9**		
Buffalo	767	247	280	29.15	29.97	.00	66.0	+1.6	86	8	74	43	11	58	26	61	58	79	1.41	−1.7	9	11,719	sw.	60	w.	15	8	18	4	4.9	0.0	0.0
Canton	448	10	61	29.43	29.90		65.7	−0.1	90	5	75	42	24	56	34				3.88	+0.4	18	7,233	sw.	33	sw.	25	17	9	4	3.3	0.0	0.0
Oswego	335	76	91		29.94	−.03	65.1	+0.3	89	3	74	44	11	56	28			73	3.77	+0.3	19		s.	31	sw.	25	5	14	11		0.0	0.0
Rochester	523	86	102	29.40	29.96	−.01	69.6	+3.5	95	5	80	45	11	60	30	60	54	61	3.69	+0.6	15	6,408	w.	29	w.	25	10	14	6	5.0	0.0	0.0
Syracuse	597	97	113	29.34	29.97	.00	68.6	+1.7	92	5	78	45	11	60	30				5.02	+1.1	16	7,802	s.	39	se.	25	6	18	6	5.4	0.0	0.0
Erie	714	130	166	29.22	29.97	−.01	71.0	+4.8	95	6	80	47	11	62	31	64	60	70	0.99	−2.8	11	9,686	w.	42	w.	15	9	19	2	4.4	0.0	0.0
Cleveland	762	190	201	29.17	29.98	.00	71.6	+4.5	93	5	80	48	11	64	33	62	57	62	1.81	−1.9	12	9,194	sw.	44	w.	8	6	16	8	5.8	0.0	0.0
Sandusky	629	62	70	29.31	29.98	.00	72.2	+3.4	97	4	81	52	10	63	37				1.24	−2.6	9	5,795	sw.	26	sw.	13	4	14	12	6.1	0.0	0.0
Toledo	628	208	243	29.30	29.97	.00	72.2	+3.5	98	5	82	49	11	62	36	63	57	61	2.66	−0.7	9	9,529	sw.	41	sw.	3	13	13	4	4.3	0.0	0.0
Fort Wayne	856	113	124	29.06	29.97		72.2	+3.7	97	5	83	50	30	62	36	62	56	60	1.76		7	6,747	s.	33	sw.	15	7	16	7	5.0	0.0	0.0
Detroit	730	218	258	29.20	29.97	.00	70.6	+3.2	96	5	80	48	10	61	32	61	55	62	4.26	+0.4	9	7,240	sw.	36	sw.	9	8	15	7	5.2	0.0	0.0
Upper Lake Region							**64.8**	**+1.8**										**69**	**2.60**	**−0.7**										**5.3**		
Alpena	609	13	92	29.28	29.94	−.02	62.1	+1.7	95	5	73	37	28	51	37	57	52	69	2.08	−1.5	11	8,063	se.	36	sw.	9	7	11	12	5.9	0.0	0.0
Escanaba	612	54	60	29.26	29.91	−.03	61.0	+0.3	82	19	70	40	29	52	32	56	53	76	2.97	−0.6	11	7,603	s.	35	n.	22	9	15	6	4.6	0.0	0.0
Grand Haven	632	54	89	29.26	29.93	−.03	65.2	+1.5	87	12	74	46	28	57	27	59	54	69	1.53	−1.0	8	8,427	s.	37	s.	12	9	16	5	5.0	0.0	0.0
Grand Rapids	707	70	87	29.19	29.95	−.02	70.4	+2.6	95	6	81	48	11	60	34	61	54	57	1.13	−1.4	8	4,645	w.	27	w.	9	8	11	11	5.7	0.0	0.0
Houghton	668	62	99	29.15	29.86	−.08	60.4	+0.4	96	5	71	38	27	50	38				3.09	−0.4	15	7,601	e.	42	sw.	9	11	13	6	5.1	0.0	0.0
Lansing	878	11	62	29.02	29.94		69.4	+3.0	96	5	82	42	11	57	38	62	56	66	2.02	−1.4	11	4,146	sw.	24	sw.	9	10	15	5	4.9	0.0	0.0
Ludington	637	60	66	29.24	29.94		60.4		85	12	69	40	11	52	29	56	52	74	2.90		16	7,882	s.	34	s.	15	12	15	3	4.5	0.0	0.0
Marquette	734	77	111	29.12	29.92	−.01	60.4	+1.5	95	5	71	37	10	50	39	55	50	68	1.73	−1.8	16	6,798	nw.	24	s.	8	8	9	13	6.4	0.0	0.0
Port Huron	638	70	120	29.27	29.96	−.01	67.4	+3.2	96	5	78	39	11	57	31	60	56	68	1.13	−2.1	9	7,777	sw.	35	w.	9	8	20	2	4.3	0.0	0.0
Saginaw	641	69	77	29.26	29.95		68.6	+1.7	95	5	80	43	11	58	36	60	54	63	1.23	−1.4	10	6,550	sw.	35	sw.	9	4	12	14	6.5	0.0	0.0
Sault Sainte Marie	614	11	52	29.23	29.92	−.04	59.4	+0.8	92	7	70	38	28	49	33	55	51	76	3.21	+0.4	14	5,793	nw.	38	nw.	26	11	11	8	5.0	0.0	0.0
Chicago	823	140	310	29.08	29.95	−.01	71.8	+3.6	96	5	80	51	10	63	26	61	55	59	4.53	+0.9	10	8,121	w.	44	s.	12	10	12	8	5.2	0.0	0.0
Green Bay	617	109	141	29.24	29.89	−.06	66.4	+1.5	91	5	76	45	10	57	31	60	55	70	5.96	+2.4	12	8,488	s.	42	ne.	15	2	24	4	5.8	0.0	0.0
Milwaukee	681	125	139	29.21	29.94	−.01	66.4	+2.5	94	5	76	46	10	56	39	59	55	66	2.54	−1.1	10	7,233	sw.	37	sw.	9	10	14	6	4.9	0.0	0.0
Duluth	1,133	5	47	28.67	29.88	−.04	58.7	+1.5	88	5	69	37	27	48	32	53	51	80	3.20	−1.3	14	8,944	ne.	40	w.	9	7	14	9	5.8	0.0	0.0
North Dakota							**62.4**	**−0.9**										**72**	**5.28**	**+1.6**										**5.4**		
Moorhead	940	50	58	28.84	29.84	−.06	64.4	0.0	90	21	75	40	10	54	33	59	55	75	5.62	+1.5	18	5,119	nw.	60	nw.	5	8	12	10	5.5	0.0	0.0
Bismarck	1,674	8	57	28.14	29.90	+.03	63.2	−0.5	89	30	74	43	9	53	34	56	51	68	6.82	+3.3	12	7,502	nw.	36	n.	7	14	10	6	4.2	0.0	0.0
Devils Lake	1,478	11	44	28.29	29.84	−.04	60.8	−1.8	86	30	71	39	10	51	29	56	52	76	4.48	+1.0	18	7,169	w.	40	nw.	18	8	12	10	5.7	0.0	0.0
Ellendale	1,457	10	56	28.31	29.86		62.4		86	21	72	41	10	53	29				11.81		13	8,967	nw.	57	e.	11	5	9	16	6.7	0.0	0.0
Grand Forks	835	12	89				62.0		85	21	72	34	10	52	28	57			9.52		21		nw.	26	nw.	9	9	11	10		0.0	0.0
Williston	1,878	41	48	27.90	29.85	−.01	61.3	−1.4	92	20	72	38	9	50	38	54	50	69	4.18	+0.6	15	6,276	w.	34	se.	10	10	12	8	5.0	0.0	0.0
Upper Mississippi Valley							**72.2**	**+1.7**										**67**	**5.95**	**+1.6**										**5.2**		
Minneapolis	918	102	208	28.88	29.85		67.2	−0.3	92	5	77	42	10	58	25				4.76	+0.8	15	8,979	s.	48	s.	2	9	10	11	5.7	0.0	0.0
St. Paul	837	236	261	28.97	29.86	−.06	66.2	−0.9	89	5	76	42	10	57	24				5.77	+1.4	13	10,120	sw.	56	sw.	2	4	19	7	5.7	0.0	0.0
La Crosse	714	11	48	29.13	29.89	−.04	68.2	−0.1	91	5	78	44	10	58	28				6.81	+2.4	17	3,969	s.	28	s.	1	11	9	10	5.5	0.0	0.0
Madison	974	70	78	28.91	29.93	−.01	67.9	+0.7	89	6	77	46	10	59	26	62	58	72	6.05	+2.0	15	5,959	sw.	35	w.	21	8	13	9	5.3	0.0	0.0
Wausau	1,247	4		28.59	29.91		65.2		90	5	75	41	10	55	29				7.57		13		s.				6	10	14	6.5	0.0	0.0
Charles City	1,015	10	49	28.85	29.91	.00	68.1	+1.6	92	5	79	44	10	58	31	61	57	69	9.39	+4.3	16	5,783	se.	29	se.	11	14	11	5	3.8	0.0	0.0
Davenport	606	71	79	29.28	29.93	−.01	72.6	+2.1	94	5	83	50	10	62	37	64	59	65	7.56	+3.4	11	5,551	s.	30	sw.	7	12	10	8	4.7	0.0	0.0
Des Moines	861	84	97	29.00	29.89	−.03	72.0	+1.4	97	20	82	51	10	62	35	64	60	68	6.44	+1.5	13	6,412	s.	37	sw.	2	10	9	11	5.3	0.0	0.0
Dubuque	700	81	96	29.17	29.90	−.03	70.2	+0.8	90	5	80	46	11	61	•37	63	58	67	10.80	+6.2	12	4,997	s.	24	sw.	8	10	12	8	5.1	0.0	0.0
Keokuk	614	64	78	29.28	29.94	.00	74.2	+1.7	94	6	84	52	10	65	37	66	61	67	4.79	+0.4	12	5,725	s.	37	sw.	15	11	10	9	5.2	0.0	0.0
Cairo	358	87	93	29.60	29.96	−.01	80.2	+3.9	95	11	89	61	26	71	31	70	66	66	5.95	+1.6	6	5,263	s.	30	sw.	22	10	8	12	5.7	0.0	0.0
Peoria	609	11	45	29.31	29.97	+.02	73.4	+2.5	95	6	84	49	30	62	41	65	61	69	3.15	−1.2	11	4,421	s.	25	s.	12	10	14	6	4.9	0.0	0.0
Springfield, Ill.	636	10	91	29.27	29.93	−.02	76.0	+3.8	97	17	87	53	11	65	40	66	62	67	3.74	−0.6	13	5,797	s.	34	s.	12	10	11	9	5.1	0.0	0.0
Hannibal	534	74	109	29.38	29.94	−.01	75.8	+3.3	94	17	86	55	10	66	32				3.27	−0.2	12	6,593	s.	36	s.	12	13	11	6	4.7	0.0	0.0
St. Louis	568	265	303	29.36	29.95	.00	78.4	+3.6	96	6	88	60	30	69	30	68	62	61	4.84	+0.4	10	9,368	sw.	55	nw.	29	11	16	3	4.9	0.0	0.0
Missouri Valley							**72.9**	**+2.1**										**66**	**5.40**	**+1.1**										**4.7**		
Columbia, Mo.	784	11	84	29.12	29.93	−.02	75.8	+3.0	93	17	86	58	9	66	31				7.07	+2.7	15	5,472	s.	42	nw.	17	11	12	7	4.5	0.0	0.0
Kansas City	963	161	181	28.89	29.89	−.03	76.5	+2.9	95	28	86	57	13	67	31	68	64	68	7.10	+2.4	13	7,228	s.	38	w.	12	13	12	5	4.2	0.0	0.0
St. Joseph	967	11	49	28.87	29.88		75.4		94	14	86	57	13	65	28	67	63	70	12.55		16	6,318	s.	35	nw.	12	17	7	6	3.9	0.0	0.0
Springfield, Mo.	1,324	98	104	28.58	29.95	.00	77.2	+4.7	93	21	86	58	25	68	25	68	63	66	3.88	−1.3	13	7,472	s.	32	nw.	12	22	7	1	2.8	0.0	0.0
Iola	984	11	50	28.88	29.89	−.04	77.9	+4.5	99	17	89	55	8	67	34				6.54	+1.8	10	4,435	s.	22	s.	2	12	15	3	4.2	0.0	0.0
Topeka	987	92	107				76.8	+3.4	100	28	87	57	13	66	32				6.05	+1.2	12	7,814	s.	36	sw.	11	12	13	5	4.2	0.0	0.0
Drexel	1,209	10	54	28.50	29.85		71.4		96	20	82	51	10	61	32				5.92		13	8,739	e.	56	sw.	1	11	10	9	5.3	0.0	0.0
Lincoln	1,189	11	84	28.62	29.84	−.06	74.2	+2.8	95	20	85	55	29	64	31	65	60	66	6.64	+2.3	13	8,683	s.	44	sw.	7	9	10	11	5.7	0.0	0.0
Omaha	1,105	115	122	28.72	29.87	−.04	73.6	+2.0	99	20	83	53	10	64	33	64	59	65	7.42	+2.4	14	5,841	se.	38	nw.	28	12	10	8	5.0	0.0	0.0
Valentine	2,598	47	54	27.19	29.85	−.04	66.7	−0.2	100	30	79	44	29	54	40	58	53	65	3.50	−0.3	12	6,967	e.	50	nw.	7	11	13	6	4.6	0.0	0.0
Sioux City	1,135	94	164	28.68	29.86	−.04	71.3	+1.8	95	20	81	51	10	61	32	62	57	63	5.36	+1.5	9	9,974	s.	76	sw.	1	9	12	9	5.3	0.0	0.0
Huron	1,306	59	74	28.50	29.88	.00	66.6	+0.4	95	21	77	46	28	56	32	60	55	68	3.37	−0.2	15	6,826	nw.	44	nw.	8	8	12	10	5.3	0.0	0.0
Pierre	1,572	70	75	28.23	29.87	.00	67.6	−0.9	98	30	78	48	9	57	34	59	54	66	3.54	+0.5	14	6,991	nw.	38	nw.	11	10	13	7	5.1	0.0	0.0
Yankton	1,233	49	57	28.56	29.85	−.04	70.2	+1.3	93	20	81	50	2	60	31				4.31	0.0	13	5,275	e.	36	sw.	7	7	15	8	5.6	0.0	0.0

TABLE 1.—*Climatological Data for Weather Bureau Stations, June, 1925*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
Northern Slope							62.1	+0.6										61	2.57	+0.3										5.1		
Billings	3,140	5					64.0	----	99	29	79	38	12	49	46	----	----	----	3.11	----	17	----	nw.	----	----	----	13	7	10	----	0.0	0.0
Havre	2,505	11	44	27.27	29.86	+.01	63.4	+1.4	94	28	75	40	5	52	37	55	50	68	5.14	+2.3	14	3,990	sw.	24	nw.	11	13	13	4	4.2	0.0	0.0
Helena	4,110	87	112	25.78	29.91	+.03	59.8	+0.6	93	26	71	35	6	49	37	50	42	59	2.89	+0.8	15	5,678	sw.	41	sw.	21	7	11	12	5.9	0.0	0.0
Kalispell	2,973	48	56	26.87	29.88	-.01	59.5	+1.8	90	26	71	37	5	48	40	50	44	64	2.07	+0.3	13	4,005	nw.	29	se.	28	8	12	10	5.6	0.0	0.0
Miles City	2,371	48	55	27.40	29.91	+.06	65.3	-0.7	98	29	76	44	9	54	38	56	50	63	2.69	-0.1	18	4,629	nw.	33	s.	29	13	10	7	4.6	0.0	0.0
Rapid City	3,259	50	58	26.56	29.91	+.06	63.4	-0.8	90	30	74	41	3	53	30	55	49	62	3.83	+0.2	15	5,498	w.	38	n.	7	10	10	10	5.4	0.0	0.0
Cheyenne	6,088	84	101	24.02	29.87	+.03	61.2	+0.8	86	28	73	38	6	49	33	50	42	57	1.81	+0.2	9	8,611	w.	44	nw.	7	9	15	6	5.3	0.0	0.0
Lander	5,372	60	68	24.63	29.88	+.03	61.4	+0.9	92	29	75	34	12	48	37	48	37	46	0.48	-0.6	8	4,413	w.	48	w.	10	10	13	7	5.0	0.0	0.0
Sheridan	3,790	10	47	26.07	29.90	----	61.2	----	93	29	74	37	3	48	42	53	47	63	1.72	----	11	3,581	nw.	28	se.	15	8	17	5	5.0	0.0	0.0
Yellowstone Park	6,241	11	48	23.90	29.94	+.08	52.8	-3.2	83	20	65	31	11	40	36	44	38	64	2.82	+1.2	16	4,867	s.	44	s.	10	6	11	13	6.0	0.1	0.0
North Platte	2,821	11	51	27.00	29.86	.00	71.7	+4.2	101	30	85	47	8	59	39	61	55	63	1.46	-1.8	8	5,681	s.	36	s.	4	15	10	5	4.0	0.0	0.0
Middle Slope							76.3	+4.4										53	2.46	-0.7										3.8		
Denver	5,292	106	113	24.72	29.87	+.03	67.2	+0.9	91	28	79	44	6	56	32	54	44	50	1.48	0.0	9	5,331	s.	34	n.	11	8	21	1	4.8	0.0	0.0
Pueblo	4,685	80	86	25.24	29.80	-.03	72.6	+3.6	95	14	87	45	8	58	44	55	43	43	0.24	-1.2	3	5,915	n.	44	w.	11	12	18	0	4.1	0.0	0.0
Concordia	1,392	50	58	28.40	29.82	-.08	77.1	+4.1	97	30	89	57	8	66	32	66	60	60	5.20	+0.2	15	7,054	s.	43	nw.	16	12	17	1	4.1	0.0	0.0
Dodge City	2,509	11	51	27.33	29.86	-.01	78.1	+5.6	101	22	91	51	8	65	35	64	56	54	2.22	-1.1	9	8,367	se.	40	se.	3	24	6	0	2.4	0.0	0.0
Wichita	1,358	139	158	28.46	29.85	-.06	80.0	+5.6	102	30	90	57	13	70	33	67	61	57	3.68	-1.1	5	11,171	s.	48	nw.	12	14	15	1	3.8	0.0	0.0
Broken Arrow	765	11	56	29.11	29.92		82.4		104	28	94	61	13	71	35	----	----	----	0.89	----	4	10,509	s.	44	nw.	12	11	15	4	4.6	0.0	0.0
Muskogee	652	4																														
Oklahoma City	1,214	10	47	28.64	29.88	-.03	82.6	+6.6	103	29	94	59	13	71	35	69	62	56	1.94	-1.1	9	7,089	s.	37	n.	9	20	7	3	2.8	0.0	0.0
Southern Slope							80.1	+2.5										50	1.26	-1.3										3.2		
Abilene	1,738	10	52	28.11	29.87	-.01	81.5	+2.3	101	13	93	60	26	70	34	68	62	58	3.09	-0.1	6	7,333	s.	33	sw.	3	16	11	3	3.4	0.0	0.0
Amarillo	3,676	10	49	26.22	29.85	.00	77.2	+4.4	100	15	90	52	7	64	39	62	53	53	1.71	-1.3	7	8,865	s.	34	se.	6	15	11	4	3.8	0.0	0.0
Del Rio	944	64	71	28.91	29.88	+.03	83.5	+1.4	96	12	92	68	1	75	21	----	----	----	0.10	-2.3	1	7,674	se.	34	se.	4	17	11	2	3.5	0.0	0.0
Roswell	3,566	75	85	26.30	29.80	.00	78.2	+1.9	98	15	92	52	8	64	39	58	43	39	0.16	-1.6	3	7,042	s.	46	se.	4	23	7	0	2.3	0.0	0.0
Southern Plateau							74.7	+0.5										40	0.14	-0.2										2.9		
El Paso	3,778	110	133	26.12	29.77	+.02	80.2	+0.6	99	11	92	55	7	68	33	58	40	31	0.17	-0.4	4	8,553	w.	38	nw.	6	20	9	1	2.8	0.0	0.0
Sante Fe	7,013	38	53	23.29	29.78	-.03	65.8	+1.0	84	19	78	41	1	54	34	49	35	37	0.30	-0.7	4	5,224	se.	37	sw.	11	12	10	8	4.4	0.0	0.0
Flagstaff	6,907	10	59	23.37	29.80	+.02	58.5	-0.8	84	6	73	29	7	44	45	45	----	49	1.53	----	9	6,810	w.	36	s.	14	16	8	6	----	T.	0.0
Phoenix	1,108	10	82	28.64	29.76	+.02	86.2	+1.7	111	23	100	58	6	72	41	68	59	44	0.21	+0.1	2	4,141	w.	36	ne.	22	17	10	3	3.3	0.0	0.0
Yuma	141	9	54	29.60	29.75	+.01	84.8	+0.1	113	23	100	51	5	69	42	65	52	39	T.	0.0	0	4,578	w.	44	e.	28	26	3	1	1.1	0.0	0.0
Independence	3,957	5	25	25.97	----	----	72.6	+0.3	103	25	89	40	5	56	46	50	----	----	0.01	-0.1	1	----	nw.	----	----	----	14	9	7	----	0.0	0.0
Middle Plateau							65.0	-0.2										44	1.37	+0.8										4.8		
Reno	4,532	74	81	25.44	29.88	+.02	63.9	+2.9	100	25	79	32	4	48	44	48	36	46	0.25	-0.1	5	5,143	w.	39	sw.	25	18	7	5	3.6	0.0	0.0
Tonopah	6,090	12	20	----	----	----	65.0	----	93	26	76	32	3	54	29	48	33	37	0.68	----	5	----	nw.	----	----	----	----	----	----	----	0.0	0.0
Winnemucca	4,344	18	56	25.58	29.91	+.03	63.6	+0.8	99	27	79	36	15	48	43	49	38	51	2.18	+1.5	12	4,121	sw.	32	sw.	29	9	13	8	5.5	0.0	0.0
Modena	5,479	10	43	24.59	29.86	+.04	61.4	-1.9	93	27	77	33	5	46	44	48	36	49	2.73	+2.3	8	8,108	sw.	50	nw.	3	13	10	7	4.5	0.7	0.0
Salt Lake City	4,360	163	203	25.57	29.87	+.02	65.6	-1.8	94	28	76	41	6	55	29	51	41	47	1.39	+0.6	10	5,317	nw.	40	w.	21	9	9	12	5.5	0.0	0.0
Grand Junction	4,602	60	68	25.33	29.85	+.02	70.4	-1.0	95	19	84	45	7	57	33	52	37	36	0.32	-0.1	8	5,267	se.	37	sw.	3	10	14	6	5.0	0.0	0.0
Northern Plateau							65.7	+2.1										52	1.26	+0.1										5.1		
Baker	3,471	48	53	26.43	29.97	+.02	60.6	+2.0	95	26	74	34	3	48	39	50	43	61	0.76	-0.4	11	4,369	se.	22	s.	21	5	17	8	5.4	0.0	0.0
Boise	2,739	78	86	27.11	29.92	+.01	66.4	+1.1	101	27	80	36	4	53	36	53	42	50	1.84	+1.0	8	3,640	se.	29	se.	27	11	7	12	5.1	0.0	0.0
Lewiston	757	40	48	29.12	29.92	-.02	69.6	+3.0	106	26	84	41	3	56	47	----	----	----	1.24	+0.2	8	2,417	e.	32	sw.	21	10	12	8	5.2	0.0	0.0
Pocatello	4,477	60	68	25.45	29.90	+.03	62.0	-0.2	93	25	74	37	4	50	39	50	42	56	2.33	+1.3	10	5,545	se.	33	sw.	9	7	13	10	5.7	0.0	0.0
Spokane	1,929	101	110	27.90	29.91	-.03	65.8	+3.0	100	26	78	38	3	53	41	52	41	48	0.64	-1.0	7	4,458	s.	24	s.	6	11	9	10	5.0	0.0	0.0
Walla Walla	991	57	65	28.86	29.92	-.04	70.0	+3.5	104	26	82	44	3	58	40	56	44	44	0.72	-0.5	4	3,625	s.	29	sw.	21	14	16	0	3.9	0.0	0.0
North Pacific Coast Region							59.3	+0.9										70	0.98	-0.9										5.6		
North Head	211	11	56	29.83	30.06	+.07	55.0	+0.2	97	24	59	44	2	51	46	52	49	83	2.33	+0.6	13	12,433	n.	44	nw.	26	4	10	16	7.2	0.0	0.0
Port Angeles	29	8	53	----	30.06	----	55.7	----	88	25	63	42	3	48	32	----	----	----	0.16	-1.1	6	6,225	sw.	38	w.	12	13	10	7	----	0.0	0.0
Seattle	125	215	250	29.92	30.05	+.05	60.1	+1.1	98	25	69	44	3	52	35	53	47	68	0.61	-0.9	8	5,328	s.	29	s.	2	9	13	8	5.3	0.0	0.0
Tacoma	194	172	201	29.83	30.04	+.01	60.0	+1.3	98	25	69	45	3	51	38	----	----	----	0.74	-0.9	7	5,304	n.	34	sw.	12	3	15	12	6.7	0.0	0.0
Tatoosh Island	86	9	53	29.95	30.05	+.03	53.5	+0.5	77	25	58	43	3	49	24	51	50	89	1.67	-2.5	9	7,587	w.	52	e.	25	7	8	15	6.5	0.0	0.0
Yakima	1,071	5	----	----	----	----	67.2	----	103	26	84	32	3	50	50	----	----	----	0.08	----	3	----	nw.	----	----	----	13	14	3	4.1	0.0	0.0
Medford	1,425	4	----	----	----	----	66.8	----	109	24	83	42	3	50	54	53	43	51	0.83	----	4	----	nw.	24	nw.	3	10	4	16	----	0.0	0.0
Portland, Oreg.	153	68	106	29.86	30.01	-.03	63.4	+1.1	101	25	74	47	2	53	37	56	51	68	0.73	-0.9	8	4,563	nw.	23	e.	24	10	7	13	5.8	0.0	0.0
Roseburg	510	9	57	29.48	30.03	.00	63.8	+1.3	106	24	78	40	3	50	53	54	47	61	0.60	-0.5	6	2,628	n.	16	n.	28	14	12	4	3.7	0.0	0.0
Middle Pacific Coast Region							64.0	+1.5										64	0.33	-0.1										3.0		
Eureka	62	73	89	29.99	30.06	+.01	55.2	+0.9	80	24	60	45	5	50	27	52	49	83	0.24	-0.8	4	5,099	n.	30	n.	12	10	12	8	5.1	0.0	0.0
Point Reyes	490	7	18	29.36	29.87	----	53.4	+0.6	84	24	57	46	9	49	31	----	----	----	T.	----	0	21,018	nw.	60	nw.	27	12	7	11	5.1	0.0	0.0
Red Bluff	332	50	56	29.50	29.84	-.04	76.8	+2.0	113	25	91	45	4	62	39	59	46	42	1.31	+0.8	4	3,776	nw.	28	nw.	13	26	3	1	1.6	0.0	0.0
Sacramento	69	106	117	29.78	29.85	-.04	72.1	+2.7	111	25	88	49	4	57	42	58	51	56	0.05	-0.1	2	5,638	s.	21	s.	28	27	3	0	1.0	0.0	0.0
San Francisco	155	208	243	29.75	29.92	-.04	60.7	+2.2	95	24	68	50	15	53	37	54	50	76	0.05	-0.1	1	7,233	w.	36	nw.	4	21	7	2	3.0	0.0	0.0
San Jose	141	12	110	29.78	29.93	----	65.8	+0.8	104	24	80	43	10	51	49	----	----	----	0.01	-0.1	1	4,833	nw.	25	se.	14	26	2	2	1.9	0.0	0.0
South Pacific Coast Region							68.0	+0.9										66	0.22	+0.1										3.4		
Fresno	327	89	98	29.48	29.82	-.03	77.0	+1.2	112	25	92	49	4	62	38	58	44	37	0.02	-0.1	1	5,841	nw.	25	nw.	25	25	3	2	1.8	0.0	0.0
Los Angeles	338	159	191	29.53	29.89	-.01	67.4	+1.0	94	27	76	52	6	59	27	60	57	76	0.56	+0.5	2	3,919	sw.	26	nw.	5	13	13	4	4.1	0.0	0.0
San Diego	87	62	70	29.81	29.90	-.02	64.6	+0.7	78	27	69	53	5	60	17	59	57	80	0.15	+0.1	4	4,788	w.	25	s.	3	10	13	7	5.3	0.0	0.0
San Luis Obispo	201	32	40	29.72	29.94	-.01	62.8	+0.6	105	26	75	42	5	51	49	54	49	72	0.15	0.0	2	3,015	nw.	16	nw.	4	22	6	2	2.5	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.01	----	79.0	-0.7	87	10	84	72	16	74	13	----	----	----	4.32	-1.6	21	9,093	e.	38	e.	28	3	18	9	6.1	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.71	29.83	-.01	80.4	+0.4	91	24	87	71	8	74	17	76	75	90	18.34	+10.5	21	4,918	nw.	29	nw.	28	0	14	16	7.7	0.0	0.0
Colon	36	7	97	29.80	29.83	-.01	81.4	+1.1	90	10	86	72	27	76	15	77	76	88	13.77	+0.4	22	6,531	n.	30	n.	18	0	4	26	8.7	0.0	0.0
Alaska																																
Juneau	80	11	54	----	----	----	52.9	----	75	25	60	39	21	46	31	49	44	73	4.93	----	15	5,464	s.	27	se.	26	7	4	19	7.2	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100	----	----	----	76.2	----	82	29	80	70	7	72	11	68	65	70	0.28	-0.6	12	7,664	e.	33	e.	28	10	14	6	5.1	0.0	0.0

TABLE 2.—*Data furnished by the Canadian Meteorological Service, June, 1925*

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	*In.*	*In.*	*In.*
St. Johns, N. F	125												
Sydney, C. B. I	48												
Halifax, N. S	88	29.81	29.91	-0.04	60.1	+2.4	70.1	50.1	91	38	6.64	+2.88	0.0
Yarmouth, N. S	65	29.81	29.88	-.07	55.4	+0.4	62.8	48.0	75	42	6.93	+4.17	0.0
Charlottetown, P. E. I	38	29.82	29.86	-.06	58.8	+1.4	67.0	50.7	82	41	2.52	-0.15	0.0
Chatham, N. B	28	29.75	29.78	-.11	60.5	+0.5	71.3	49.7	86	36	3.02	-0.44	0.0
Father Point, Que	20	29.79	29.81	-.06	54.4	+1.4	61.9	46.8	78	35	2.44	-0.54	0.0
Quebec, Que	296	29.56	29.88	-.04	62.8	+1.6	72.6	53.0	85	41	3.58	-0.07	0.0
Montreal, Que	187	29.67	29.87	-.07	65.9	+1.0	75.1	56.7	94	47	3.22	-0.31	0.0
Ottawa, Ont	236	29.62	29.88	-.06	66.2	+0.9	76.9	55.6	97	44	3.24	+0.32	0.0
Kingston, Ont	285	29.62	29.93	-.04	62.8	-0.6	70.5	55.0	84	44	3.07	+0.64	0.0
Toronto, Ont	379	29.54	29.93	-.04	66.7	+3.3	77.2	56.3	95	42	2.10	-0.70	0.0
Cochrane, Ont	930				56.4		68.0	44.8	87	30	6.85		T.
White River, Ont	1,244	28.56	29.86	-.08	57.4	-1.3	69.8	45.0	90	30	4.08	+1.86	0.0
Port Stanley, Ont	592												
Southampton, Ont	656	29.23			60.5	+0.1	70.2	50.9	86	38	3.04	+0.69	0.0
Parry Sound, Ont	688	29.24	29.92	-.04	59.8	-1.9	71.9	47.7	87	41	3.26	+0.84	0.0
Port Arthur, Ont	644	29.17	29.88	-.06	58.0	+1.6	68.5	47.5	85	34	4.04	+1.31	0.0
Winnipeg, Man	760	29.01	29.83	-.06	60.7	-1.5	70.8	50.7	88	38	2.37	-0.92	0.0
Minnedosa, Man	1,690	28.06	29.85	-.04	57.0	-2.6	66.5	47.5	81	35	3.07	+0.07	0.0
Le Pas, Man	860				55.8		67.1	44.6	85	32	3.64		0.0
Qu'Appelle, Sask	2,115	27.62	29.84	-.03	57.7	-2.2	67.9	47.6	80	36	5.30	+1.88	0.0
Medicine Hat, Alb	2,144	27.55	29.76	-.09	65.1	+3.1	78.2	52.1	96	38	3.40	+0.64	0.0
Moose Jaw, Sask	1,759				60.1		70.6	49.7	89	40	7.11		0.0
Swift Current, Sask	2,392	27.34	29.81	-.06	60.2	+0.2	71.2	49.2	88	39	1.56	-1.11	0.0
Calgary, Alb	3,428												
Banff, Alb	4,521	25.36	29.86	+.02	54.3	+2.8	67.7	40.8	90	29	2.82	-0.51	0.0
Edmonton, Alb	2,150	27.60	29.86	+.02	58.0	+1.1	70.5	45.6	85	35	2.43	-0.43	0.0
Prince Albert, Sask	1,450	28.34	29.90	+.03	59.0	+1.3	70.1	47.8	83	40	4.53	+2.02	0.0
Battleford, Sask	1,592	28.17	29.89	+.03	60.2	+0.7	71.9	48.5	82	36	3.56	+0.25	0.0
Kamloops, B. C	1,262												
Victoria, B. C	230	29.76	30.01	.00	57.7	+1.4	65.5	49.9	95	45	0.27	-0.93	0.0
Barkerville, B. C	4,180												
Prince Rupert, B. C	170												
Hamilton, Ber	151	30.05	30.21	+.09	76.4	+1.4	81.9	70.8	85	65	0.97	-4.98	0.0

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Winnipeg, Man	760	29.17	30.02	.00	44.8	+8.9	54.7	34.9	71	24	1.12	+0.07	0.0
St. Johns, N. F	125	29.67	29.81	-.08	34.4	-0.1	39.6	29.2	60	20	4.45	+0.29	19.5

MAY, 1925

St. Johns, N. F	125	29.70	29.84	-.14	44.2	+1.3	52.1	36.2	68	32	4.88	+1.22	0.0
Sydney, C. B. I	48	29.88	29.93	-.04	46.4	+1.2	55.8	37.1	68	29	3.02	-0.75	0.0
Winnipeg, Man	760	29.15	29.98	+.02	50.8	-0.8	63.5	38.2	83	22	0.29	-1.99	T.
Kamloops, B. C	1,262	28.64	29.92	+.03	61.3	+2.2	76.0	46.6	88	31	0.71	-0.53	0.0
Barkerville, B. C	4,180	25.64	29.93	+.09	46.9	+1.4	59.7	34.2	70	23	0.58	-1.94	1.3

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(Plotted by Wilfred P. Day)

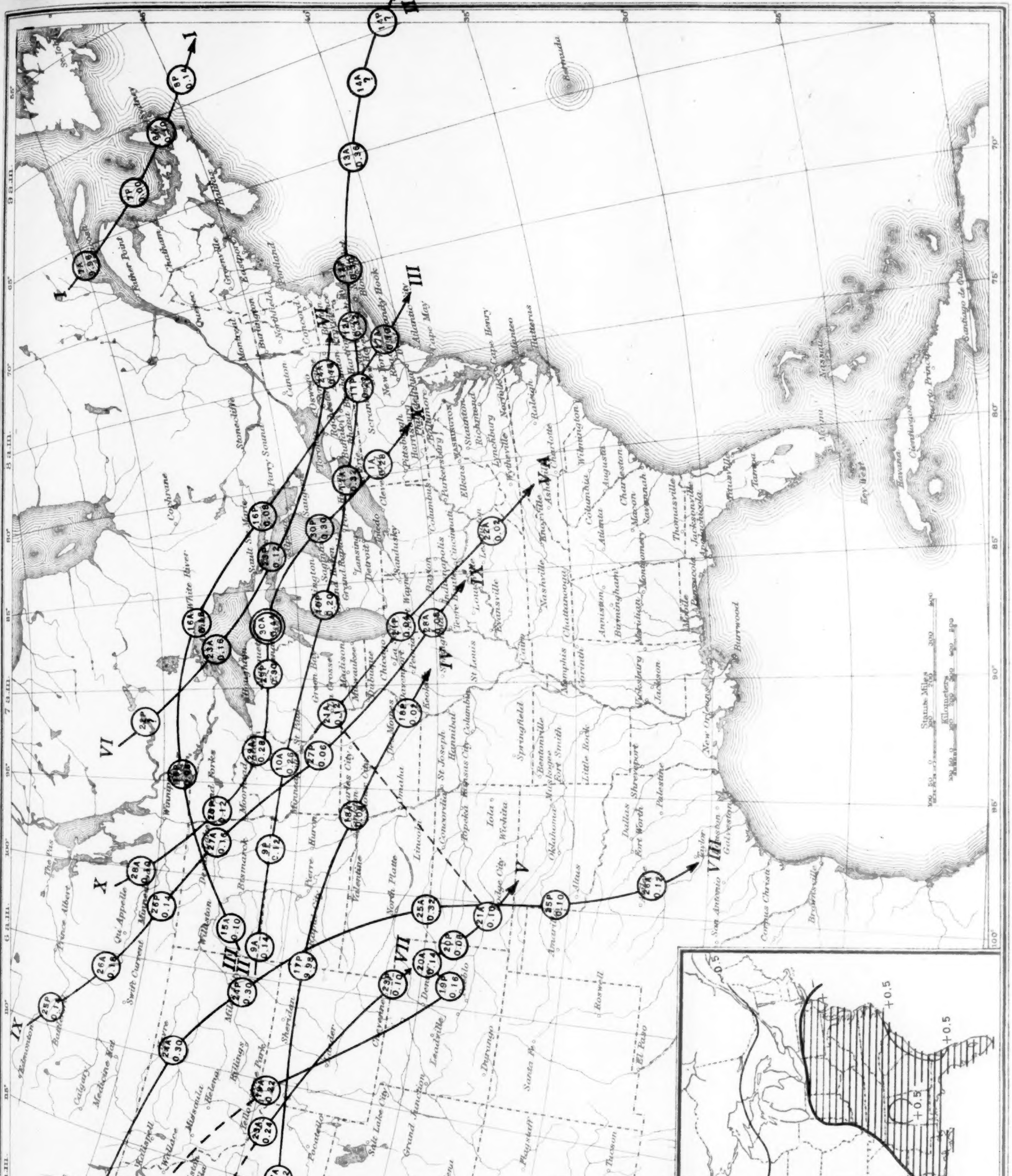

Chart II. Tracks of Centers of Cyclones, June, 1925. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by Wilfred P. Day)

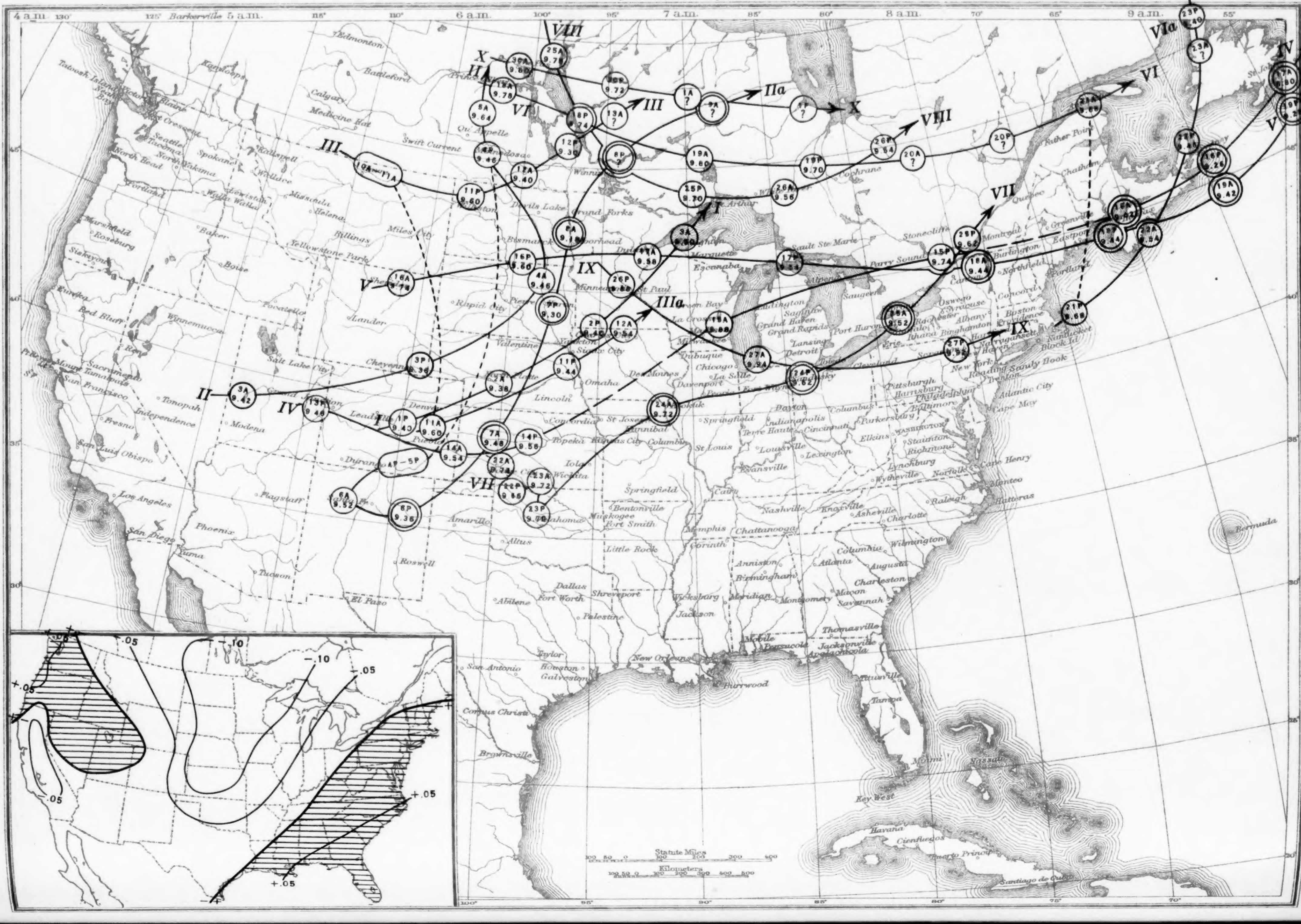

Chart III. Departure (°F.) of the Mean Temperature from the Normal, June, 1925

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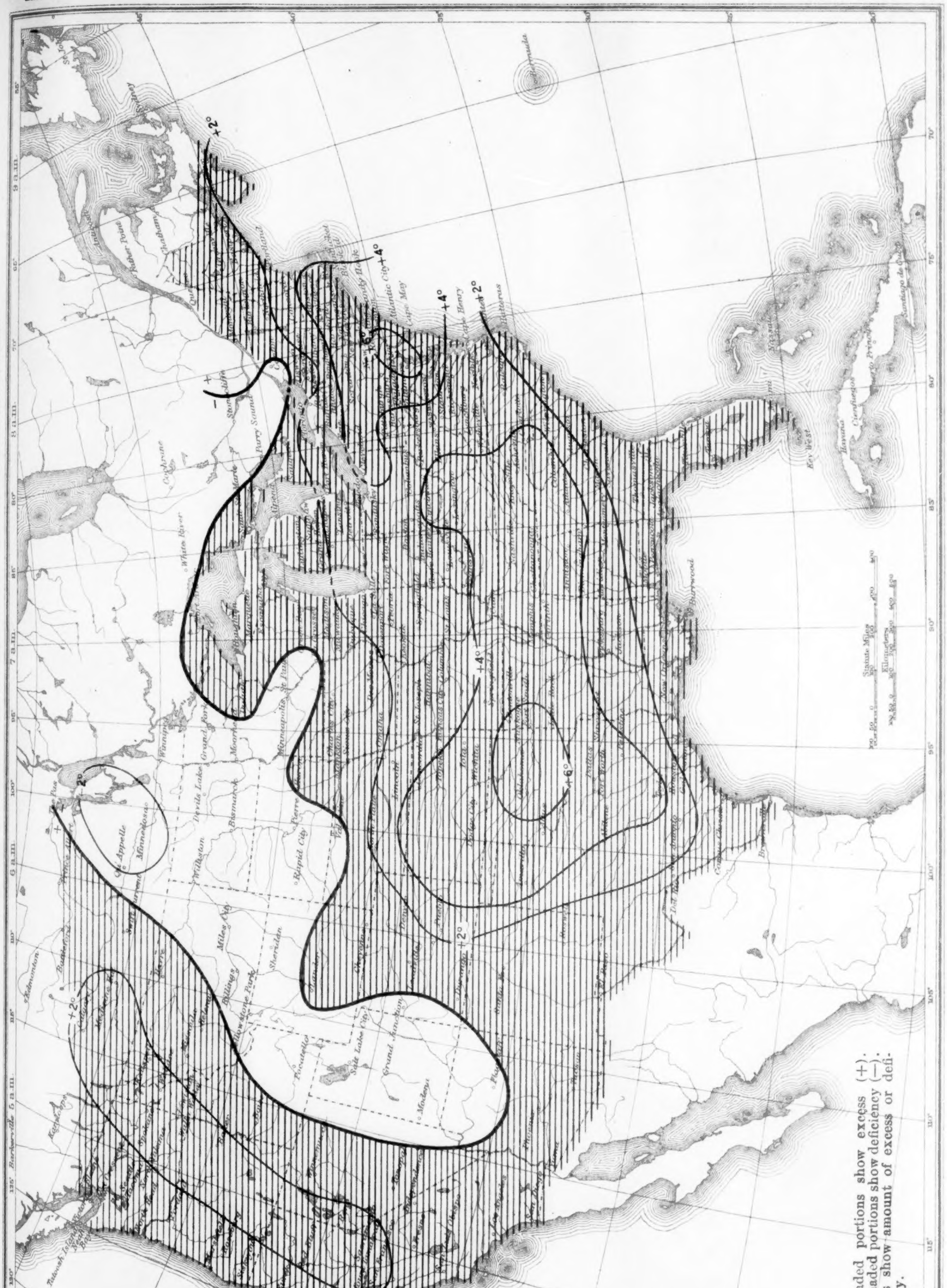


Chart IV. Total Precipitation, Inches, June, 1925. (Inset) Departure of Precipitation from Normal

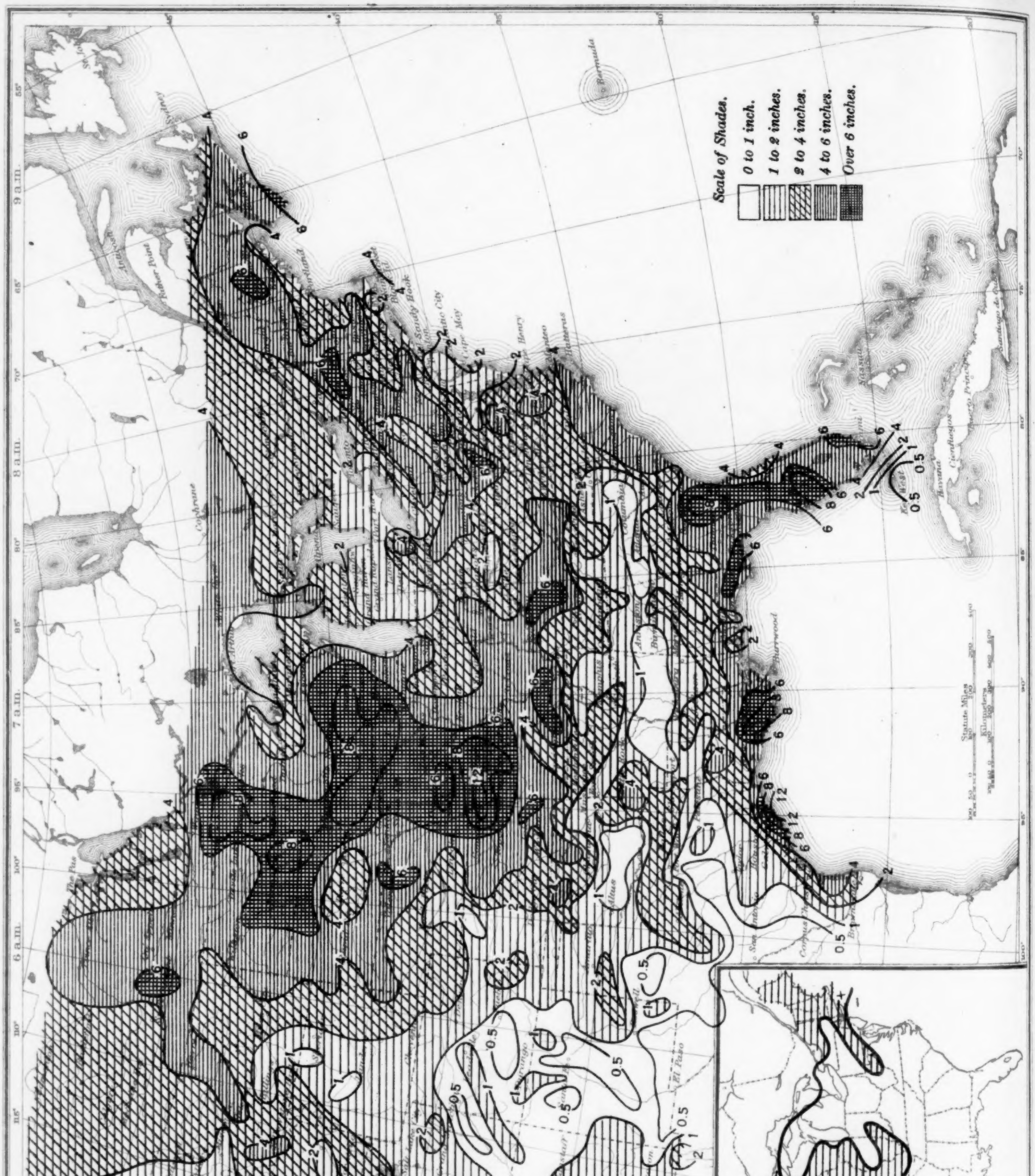


Chart V. Percentage of Clear Sky between Sunrise and Sunset, June, 1925

Chart V. Percentage of Clear Sky between Sunrise and Sunset, June, 1925

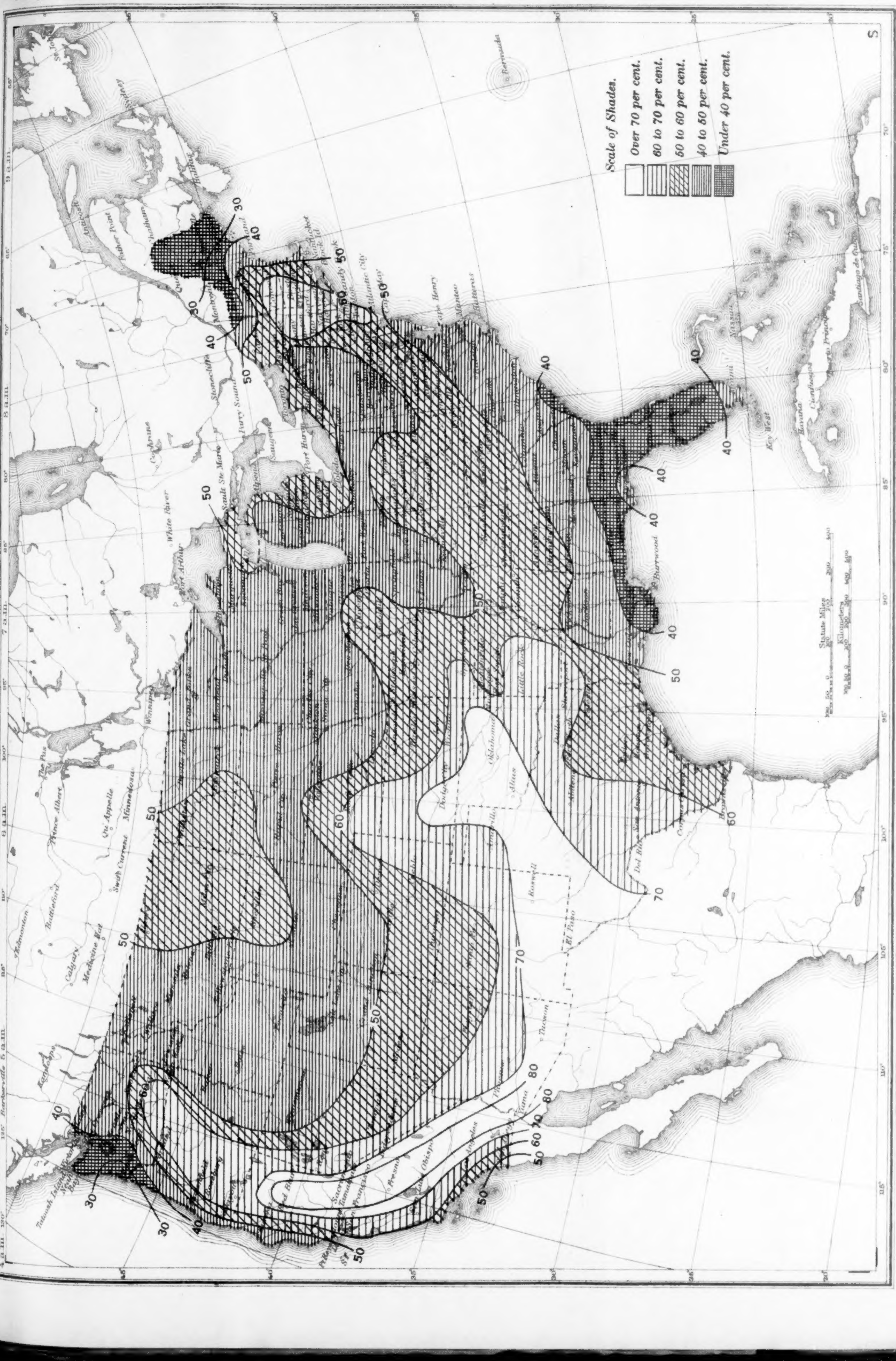
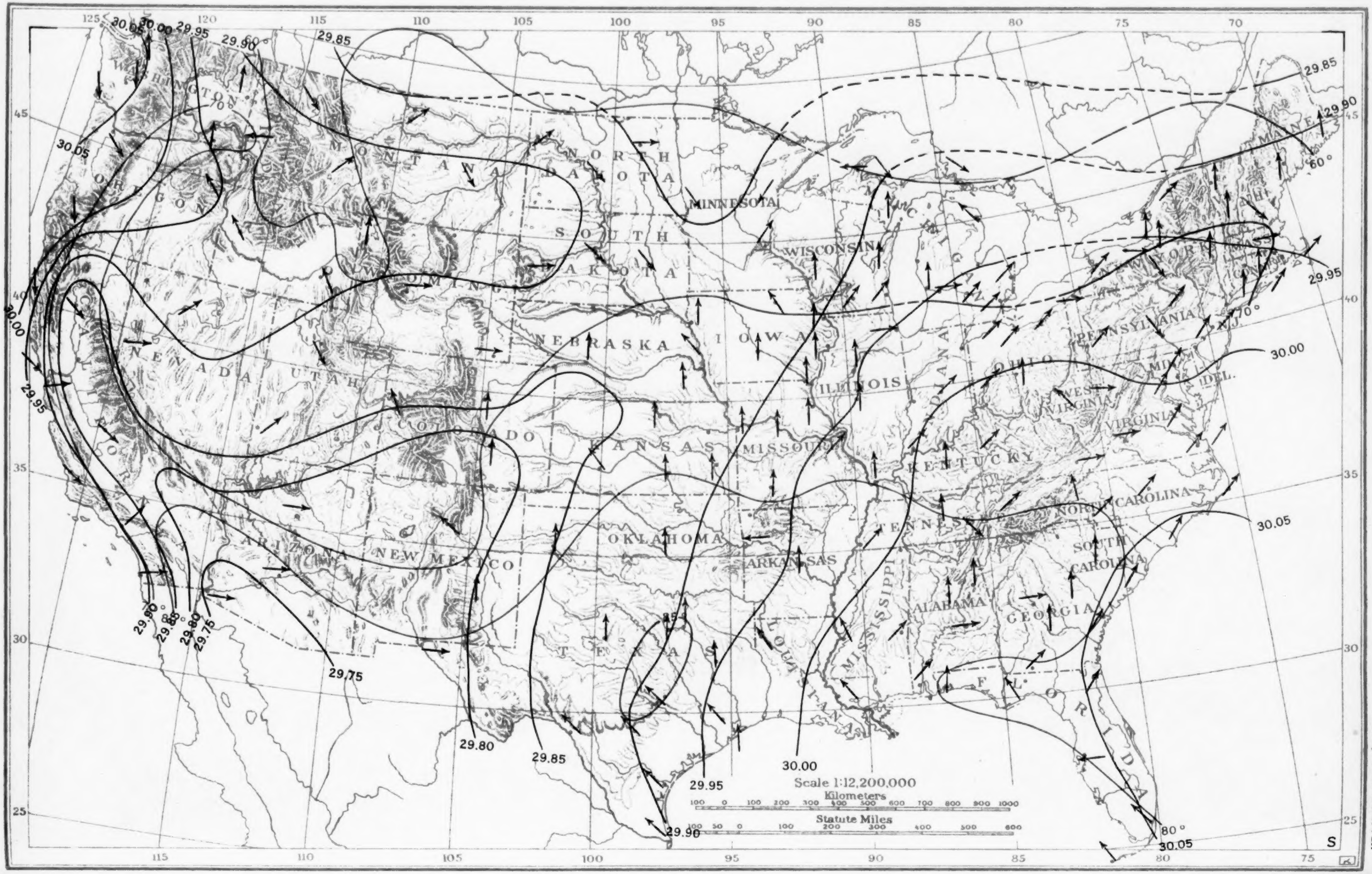


Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, June, 1925



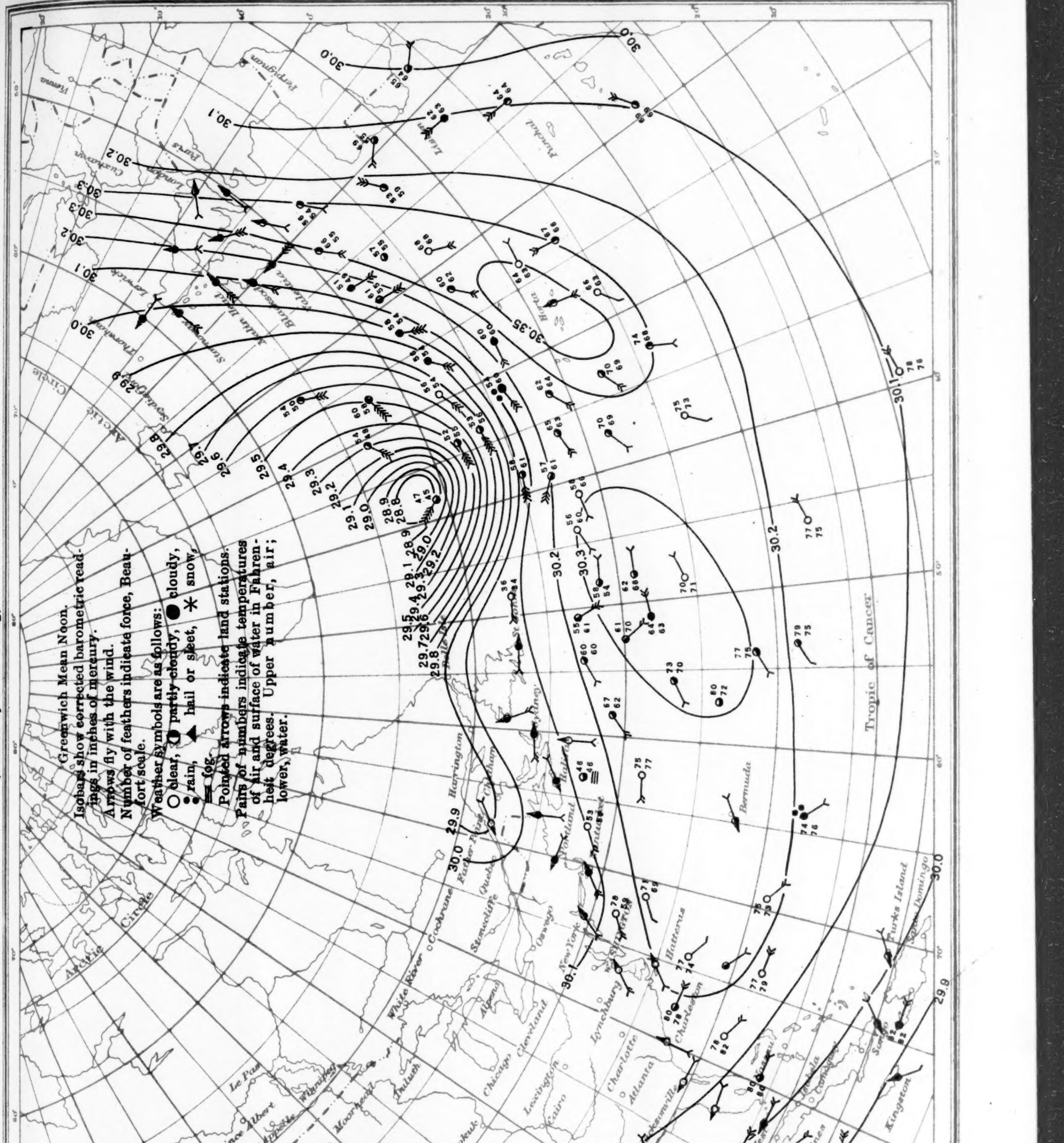
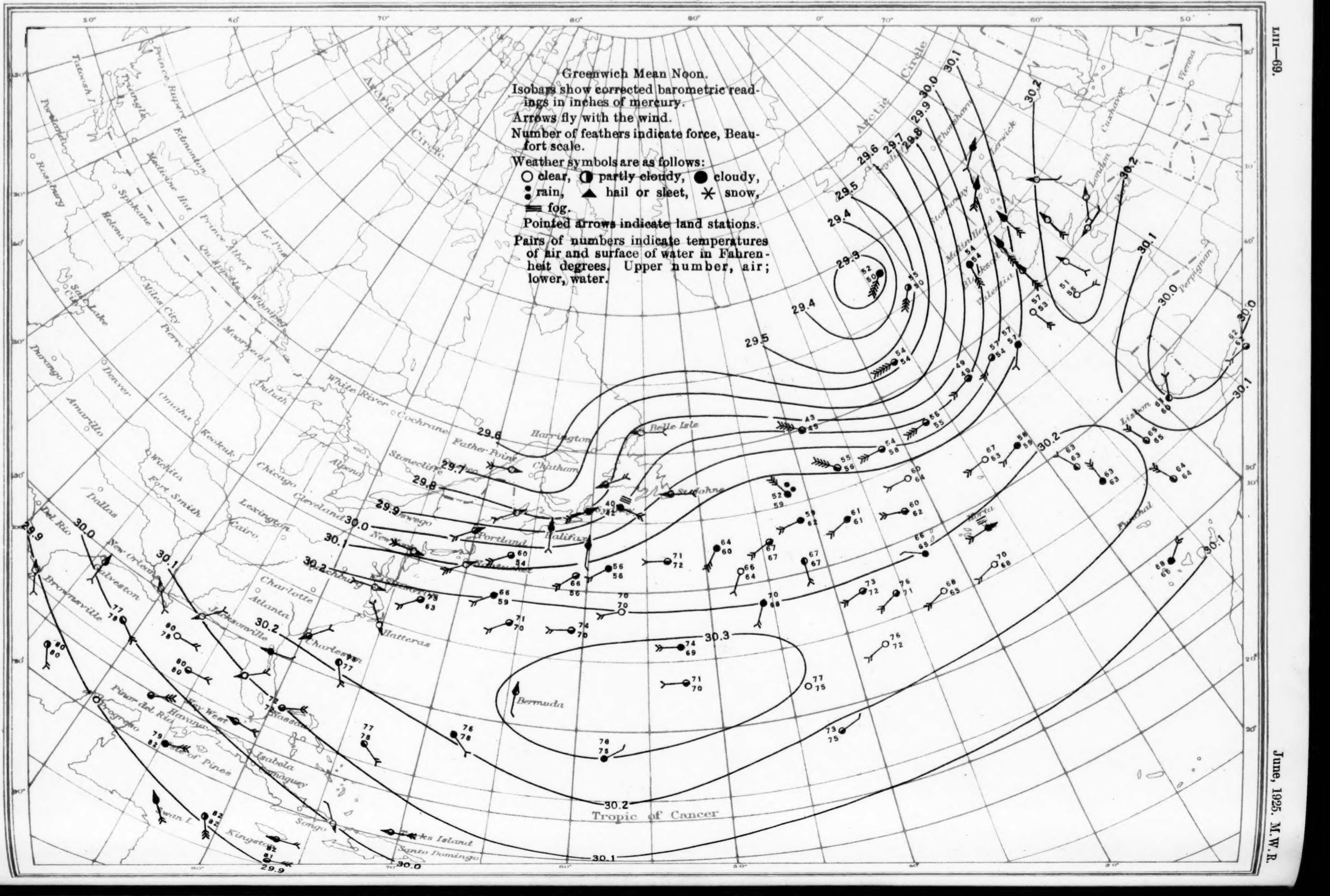
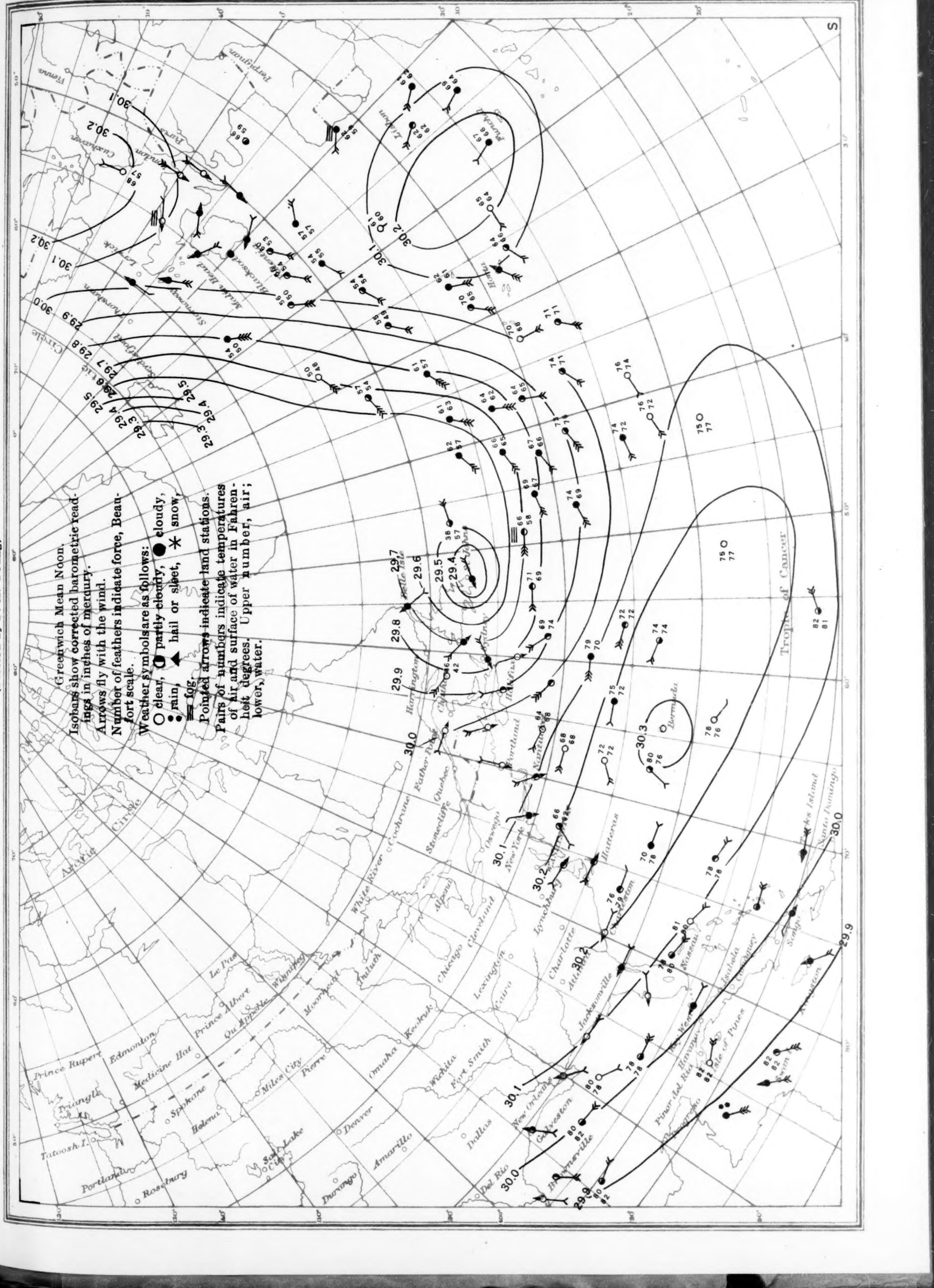

(Plotted by F. A. Young)
Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows: clear, partly cloudy, cloudy, rain, hail or sleet, snow, fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Tropic of Cancer
Arctic Circle
Bermuda
Hatteras
Charleston
Kingston
Turks Island
Cuxhaven
Paris
London

Chart IX. Weather Map of North Atlantic Ocean, June 4, 1925

(Plotted by F. A. Young)




(Plotted by F. A. Young)
Greenwich Mean Noon.
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Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Tropic of Cancer
Arctic Circle
Bermuda

Chart XI. Weather Map of North Atlantic Ocean, June 6, 1925

(Plotted by F. A. Young)